**Euro Accessories Pin Anchor Exposure**

The hot dip galvanised version of the pin anchor system should give a fifty year life expectancy in moderately exposed environments without needing to resort to actual checks on material deterioration. However in aggressive environments such as coastal placements the pins may need inspecting if the surface coating has fully oxidised and its sacrificial potential has been fully realised.

The crucial diameter to consider is the shaft diameter of the pin, this can be measured under the head of the pin with a pair of external callipers that will fit inside the hemispherical pocket the anchor sits in.

Below are the anchor load ratings in tonnes with the minimum permissible shaft diameter.

| | |
|---|---|
| 1.3 t | 9.0mm |
| 2.5t | 13.5mm |
| 5.0t | 19.0mm |
| 7.5t | 23.0mm |
| 10.0t | 27.5mm |
| 15.0t | 33.0mm |
| 20.0t | 37.5mm |
| 32.0t | 48.0mm |

These figures take into account minimum manufacturing tolerances with a 0.5mm allowance for reduction in diameter due to corrosion. They are an absolute minimum and should not be reduced without prior discussion with Euro Accessories, we can offer a proof loading test for any cast in anchors that you may feel are suspect or warrant retesting.

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March 2017

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## Introduction

The Pin Anchor System has been used successfully worldwide by companies to handle precast concrete units of various weights and dimensions for over 30 years. This manual has been produced to allow the engineer to calculate specific Pin Anchor requirements.

## Advantages

The Pin Anchor System has a "no fuss" engage and release mechanism on the Pin Anchor Lifting Ring Clutch, allowing precast concrete units to be handled economically and quickly, especially when repeated operations are required. The unique gravity action of the system prevents any possibility of accidental release of the concrete unit, whilst also giving a clear visual indication of correct engagement. The Pin Anchor System avoids the need to utilise threaded lifting systems with wire ropes and the relative precautions associated with them. The lack of easily wearing parts and the simplicity of the Lifting Ring Clutch means that they will see many years use, with only basic care.

All lifting components within the Pin Anchor System undergo specific testing procedures. Every Pin Anchor Ring Clutch is individually tested and comes uniquely stamped with a corresponding lifting certificate.

There are six simple steps to utilise the Pin Anchor System:

1. Select the correct capacity and length of Pin Anchor.

2. Insert the Pin Anchor into a corresponding Recess Former, these are re-useable and with adequate cleaning and care should see many repeat uses.

3. Once the Pin Anchor is firmly in place the concrete can be poured.

4. After sufficient concrete strength has been achieved the Recess Former can be removed from the concrete, revealing the head of the Pin Anchor with its safe working load clearly indicated. The Recess Former leaves the anchor below the concrete surface in a hemispherical pocket of a size specific to the corresponding Pin Anchor Ring Clutch.

5. Engage the Pin Anchor Ring Clutch with the Pin Anchor and rotate the head approximately 90 degrees until the foot lies flat on the concrete surface to indicate correct engagement, the base should be orientated to point in the direction of the lifting chains, ie towards the crane hook.

6. Attach lifting chains and commence lifting. The unique spherical nature of the lifting system means that the Ring Clutch will come into correct alignment, and the universal joint of the Lifting Ring Clutch will allow lifting at any angle. Simply reverse section 5 to disengage the Pin Anchor Ring Clutch.

## Overview of the Pin Anchor System

The Pin Anchor system is supplied in a wide range of lifting capacities ranging from 1.3 tonnes to 32.0 tonnes. The method of use is the same throughout the size range. There are three basic components to the range.

### 1. Pin Anchor

The Pin Anchor is permanently cast into the concrete unit. It is manufactured from specially ductile steel, making it safe to use at low temperatures. The round hot forged head of the anchor is clearly stamped with the safe working load in tonnes and is designed to engage with the Pin Anchor Ring Clutch. The base of the Pin Anchor is of a larger diameter to the head but is similarly hot forged. This provides excellent anchorage and load transmittal into the surrounding concrete. This method of transferring loads into the surrounding concrete means that except for minor exceptions, the Pin Anchor system operates without additional reinforcement. This not only reduces costs but reduces set up times. The safe working load of the pins is based on a factor of 3 for safety. See table 2 and figure 1 on the following page for details.

All anchors in the range are regularly batch tested to verify the safety factors applied to them. Every anchor has it's batch number clearly stamped on the base, allowing easy access to material analysis reports and batch test results.

### 2. Recess Formers

The Recess Former is manufactured from rubber and is hemispherical in shape. It is designed to open to allow the Pin Anchor to be inserted, once closed it provides an adequate seal to prevent concrete ingress. Once the concrete has been poured and cured the Recess Former is removed to reveal the Pin Anchor in its pocket. The Recess Formers should be oiled and can be used many times over.
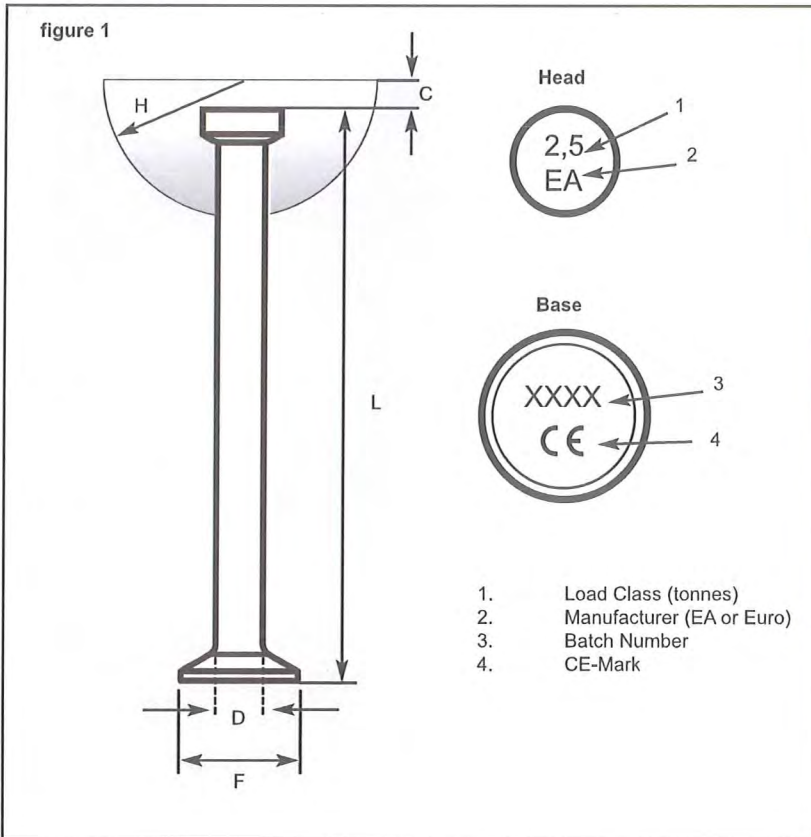
In addition there are formers available in narrow widths to ease placement in thin panels. The formers are also offered as a non- articulated item with an alternative method of securing the Pin Anchor in place. These items are detailed on pages 23 and 24 .

### 3. Pin Anchor Ring Clutch

The Pin Anchor Ring Clutch is an all cast item specially designed not only to fit the Pin Anchor of it's related safe working load but also to match the hemispherical pocket created by the corresponding capacity Recess Former. In this way, one can be assured that no two lifting capacities can be utilised together. Thus guaranteeing the safe working load is matched for all items utilised in the lifting process. The Pin Anchor Ring Clutches are individually tested and come uniquely stamped with a corresponding lifting test certificate. The safe working load of the ring clutch is based on a factor of 3 for safety.

## Embedment Details

figure 1



Head

2,5
EA

1
2

Base

XXXX
CE

3
4

1. Load Class (tonnes)
2. Manufacturer (EA or Euro)
3. Batch Number
4. CE-Mark

The concrete cover dimension C is applied throughout the Pin Anchor range and applies to anchors detailed on pages 17, 19, 20 and 21. The combination of anchor length L and concrete cover C give anchor embedment E. In addition this combined figure should be considered when determining if adequate concrete cover is being given to the base of the anchor. See figure 1 and table 2.

**table 2**
Dimensions of Pin Anchors and their Embedment

| Load Rating (tonnes) | D (mm) | F (mm) | Former Radius H (mm) | Concrete Cover C (mm) | Pin Anchor Length L (mm) |
|---|---|---|---|---|---|
| 1.3 | 10 | 25 | 30 | 10 | 35, 40, 50, 55, 65, 85, **120** |
| 2.5 | 14 | 35 | 37 | 11 | 45, 55, 65, 70, 85, 100, 120, 140, **170**, 180, 210, 280 |
| 5.0 | 20 | 50 | 47 | 15 | 65, 75, 80, 85, 95, 100, 110, 120, 140, 150, 160, 170, 180, **240**, 340 |
| 7.5 | 24 | 60 | 60 | 15 | 85, 95, 100, 120, 140, 150, 160, 165, 200, **300**, 540 |
| 10.0 | 28 | 70 | 60 | 15 | 85, 100, 110, 115, 120, 135, 150, 170, 200, 220, 250, **340**, 650, 680 |
| 15.0 | 34 | 85 | 80 | 15 | 140, 150, 165, 200, 210, 300, **400**, 480 |
| 20.0 | 39 | 98 | 80 | 15 | 165, 200, 250, 340, **500**, 1000 |
| 32.0 | 50 | 135 | 108 | 27 | 175, 280, 500, **700**, 1200 |

Embedment (E) = C + L
Notes: Dimensions in **bold** text are prefered lengths.

## Selecting the Correct Pin Anchor

Selection of the correct Pin Anchor is based upon two main factors. Firstly the safe working load of the Pin Anchor itself and its ability to carry the units in question under all relevant loading conditions at the time of lifting. Such as, weight of unit, de-moulding forces, dynamic loading, the number of effective lifting points and increased tension in angled lifting slings.

Secondly the strength of the surrounding concrete and its ability to resist pull out forces induced upon it by the lifting systems. This can be influenced by several factors. Such as, the compressive strength of the concrete, the Pin Anchor length, edge distances, the distance between adjacent Pin Anchors and the ability of thin panels to resist compressive loads damaging the faces.

This manual will guide you through the necessary steps to determine both of these criteria. Firstly the following should be noted. The normal minimum factor of safety for pull out is 2.5 and tables in this manual are based upon this.

The longest prefered anchor in each load range is designed to give a safety factor of five in concrete of 30 N/mm² compressive strength at an ideal edge distance three times its embedment from any edge and six times its embedment from any adjacent anchor. It is highly advisable to utilise prefered anchor sizes and only deviate from this when other circumstances will not allow its use.

No lifting should take place below 7.5 N/mm².

## Calculating the Pin Anchor Load Rating

The load rating required is determined by the final load value on the anchor. This value is derived from a combination of loads and factors influencing the anchor during the lifting process. These are as follows:

> The static or dead weight of the actual concrete unit, this is load **W**.
>
> The quantity, and positioning of anchors with their sling arrangements. The number of effective anchors is divisible into the dead weight of the unit giving the actual weight per anchor **z**.
>
> The angle of lift (angle of sling or chains connecting to anchor from the vertical), this is factor **Sa**.
>
> Removing a unit from the formwork increases the load on the anchor and is related to the surface area of formwork in contact with the concrete. This will influence the mould adhesion factor **Ma**.
>
> The speed at which the unit is hoisted and ground conditions the unit is being transported over. This is the dynamic load factor **V**.

In order to accurately determine the correct size of anchor to be used all these loads and factors have to be combined.

### Static Weight

This is the actual mass of the concrete and for general purposes is determined from a figure of 2.5 tonnes per cubic metre of concrete. Thus the volume in cubic metres multiplied by a density of 2.5 tonnes/m³ will give us the unit's static weight **W** in tonnes.

### Number and Positioning of Anchors and Slings

The weight carried by each anchor is directly affected by the number of anchors being used to carry the unit, and their orientation about the centre of gravity of the unit. It is important that the anchors are placed equidistant about the centre of gravity in any one axis. At this stage it is also worth noting that the number of slings and type of sling system will also affect the load on the anchors. For this reason unless there is some means of balancing the slings, we can only assume that if four slings are connected to four anchors in an unbalanced system, only two anchors effectively take the weight of the unit, therefore half the weight of the unit is being carried by each anchor. The actual static load per anchor **z** is the static weight of the unit **W** divided by the number of effective anchors.

Please see figure 2 giving the number of effective anchors for a specific sling arrangement.



figure 2

2 Effective Anchors

3 Effective Anchors

3 Effective Anchors

4 Effective Anchors
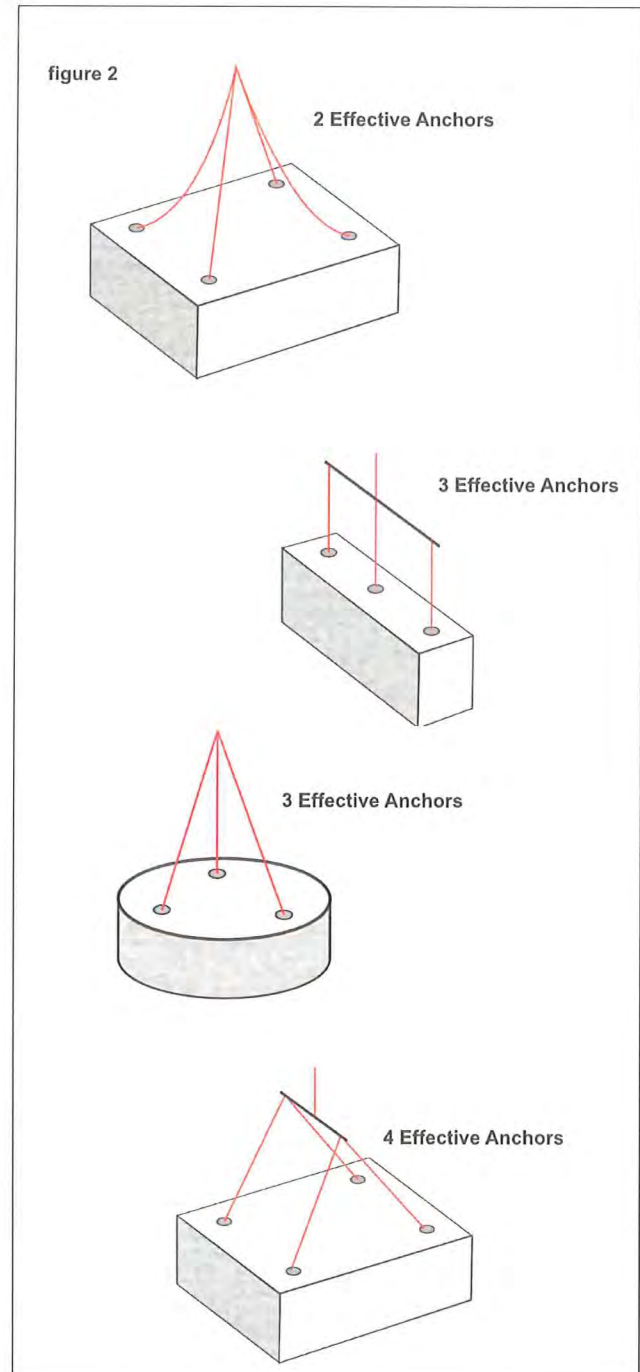
## Angle of Lift

Any inclination of the sling angle from vertical will have a direct result on the load induced on the anchor via the lifting slings. The following values in table 3 and figure 3 apply for this factor **Sa**.

**table 3**
Single Angle Load Factors

| Angle from Vertical a° | Factor Sa |
|---|---|
| 0 | 1.00 |
| 15 | 1.04 |
| 30 | 1.16 |
| 45 | 1.41 |
| 60 | 2.00 |

**figure 3**
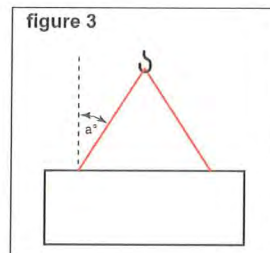


## Removing the Unit from the Formwork

Considerable loads can be induced on the anchors whilst attempting to remove a concrete unit from the formwork (demoulding). This load is influenced greatly by the type of formwork material utilised and the surface area directly in contact with the concrete. The load values per square metre are given in table 4 for various formwork materials. This figure will give us the mould adhesion factor **Ma** and is calculated as follows:

**Ma = (W+ (S x Al))/W**

> Where **W** is the static weight of the unit;
> Where **S** is the surface area of formwork in contact with the unit in m²;
> Where **Al** is the load per m² for various formwork materials obtained from table 4.

**table 4**
Demoulding Factors

| Formwork Materials | Load per m² Al (Kg) |
|---|---|
| Flat Steel Shutters | 100 |
| Flat Plywood Shutters | 200 |
| Flat Sawn Boards | 300 |

For special shaped elements the following factors for **Ma** apply:

| | |
|---|---|
| Double T Beams | **Ma=2.00** |
| Coffered Slabs | **Ma=3.00** |

It is important to note that this factor only influences demoulding and plays no part in any general lifting operation and can therefore be ignored for general lifting purposes.

## Speed of Hoist and Transport

Dynamic forces caused by the speed at which a unit is hoisted and the terrain it is transported over also affect the load induced on an anchor. The factor **V** for various rope speeds and terrain are given in table 5.

**table 5**
Rope Speed and Transport Factors

| Lifting Conditions | Factor V |
|---|---|
| Static crane with rope speed below 90 metres/min | 1.00 |
| Static crane with rope speed above 90 metres/min | 1.30 |
| Lift and transport with mobile crane on smooth ground | 1.75 |
| Lift and transport with mobile crane on uneven ground | 2.00 |
| Lift and transport over rough ground | 3.00 |
| Note at demould stage the unit is static hence the factor is effectively 1. | |

It must be noted that the means of lifting and transportation of units utilising the anchors can have a dramatic effect on the final load generated. With this in mind it must be stressed that great consideration must be taken whilst determining this factor. It is important not only to consider factory conditions but the conditions the unit will be handled under, outside the production facility.

## Calculating The Load Per Anchor

With all these conditions and factors in mind the load rating of the anchor can be calculated as follows:

### Demoulding:

For demoulding we consider the dead weight per anchor $z$, the mould adhesion factor $Ma$ and the increases in load caused by the angle of lift $Sa$. The unit is effectively static at demould stage so dynamic loads need not be considered. The calculation is as follows:

Load per anchor $Fe = z \times Ma \times Sa$

### General lifting:

For general lifting we consider the dead weight per anchor $z$, the increases in load caused by the angle of lift $Sa$ and the dynamic load factor $V$. The calculation is as follows:

Load per anchor $Fe = z \times Sa \times V$

Where:

> $z$ is the dead weight of the concrete per anchor in tonnes. Derived from $W$ divided by the number of effective anchors.
> $Ma$ demould factor determined from:
> $Ma = (W + (S \times Al))/W.$
> $Sa$ is the increased load factor due to sling angles.
> $V$ is the dynamic load factor due to rope speed and transport conditions.

With this load calculated and if the same anchor is to be used for both demould and lifting, the higher load value should be considered. This value if not an exact match to an available anchor range should be rounded up to the next available. Where concrete dimensions allow, the corresponding prefered length anchor should be utilised.

## Strength of Concrete and Resistance to Pull Out Forces

Once the correct load rating of the required anchor is calculated, we need to asses the ability of the surrounding concrete to resist pull out forces. This is influenced by several factors, such as its compressive strength, the position of anchors in relation to any edges and the position of adjacent anchors. The optimum pull out resistance $Po$ for the Pin Anchor system is achieved when the anchor is placed a distance at least three times its embedded depth $E$ from any edge and at least six times its embedded depth $E$ from any adjacent anchor. This is based on the flat pull out cone that this type of anchor produces. This ratio remains constant throughout the size range but the optimum pull out value is affected by the compressive strength of the concrete. The pull out values $Po$ for varying concrete strengths can be checked in the following tables 6 and 7.

The influences of these factors are covered on the following pages. Please note: providing the minimum edge distances and centre to centre distances are met and the pull-out value relative to concrete strength is sufficient to meet the demands calculated for the load on the anchor, the following sections can be largely ignored. Note: $E$ is devived from anchor length $L$ + Concrete Cover $C$.

## Optimum Pull Out Values for Various Anchors in Relation to Concrete Strength

**table 6**
Optimum Pull Out Values **Po** (tonnes) in Relation to Concrete Strength **B**

| Capacity (tonnes) | Anchor Length L (mm) | Embedded Depth E (mm) | Concrete Compressive Strength B | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 7.5 N/mm² | 10 N/mm² | 15 N/mm² | 20 N/mm² | 30 N/mm² | 40 N/mm² | 50 N/mm² |
| 1.3 | 40 | 50 | 0.35 | 0.43 | 0.56 | 0.68 | 0.89 | 1.08 | 1.26 |
| 1.3 | 50 | 60 | 0.51 | 0.62 | 0.82 | 0.99 | 1.30 | 1.58 | 1.84 |
| 1.3 | 55 | 65 | 0.61 | 0.74 | 0.97 | 1.17 | 1.54 | 1.86 | 2.17 |
| 1.3 | 65 | 75 | 0.82 | 0.99 | 1.30 | 1.57 | 2.06 | 2.50 | 2.91 |
| 1.3 | 85 | 95 | 1.32 | 1.61 | 2.11 | 2.55 | 3.35 | 4.06 | 4.72 |
| **1.3** | **120** | **130** | **2.51** | **3.04** | **3.99** | **4.84** | **6.35** | **7.70** | **8.94** |
| 2.5 | 45 | 56 | 0.48 | 0.58 | 0.76 | 0.93 | 1.21 | 1.47 | 1.71 |
| 2.5 | 55 | 66 | 0.67 | 0.81 | 1.06 | 1.29 | 1.69 | 2.05 | 2.38 |
| 2.5 | 85 | 96 | 1.41 | 1.71 | 2.24 | 2.72 | 3.57 | 4.33 | 5.03 |
| 2.5 | 120 | 131 | 2.63 | 3.18 | 4.18 | 5.07 | 6.65 | 8.06 | 9.36 |
| **2.5** | **170** | **181** | **5.01** | **6.08** | **7.98** | **9.67** | **12.69** | **15.39** | **17.87** |
| 2.5 | 280 | 291 | 12.96 | 15.71 | 20.62 | 25.00 | 32.81 | 39.78 | 46.20 |
| 5.0 | 75 | 90 | 1.24 | 1.50 | 1.97 | 2.39 | 3.14 | 3.81 | 4.42 |
| 5.0 | 95 | 110 | 1.85 | 2.25 | 2.95 | 3.57 | 4.69 | 5.68 | 6.60 |
| 5.0 | 120 | 135 | 2.79 | 3.38 | 4.44 | 5.38 | 7.06 | 8.56 | 9.94 |
| 5.0 | 180 | 195 | 5.82 | 7.06 | 9.26 | 11.23 | 14.73 | 17.86 | 20.74 |
| **5.0** | **240** | **255** | **9.95** | **12.07** | **15.83** | **19.20** | **25.19** | **30.55** | **35.47** |
| 5.0 | 340 | 355 | 19.29 | 23.39 | 30.69 | 37.21 | 48.83 | 59.20 | 68.75 |
| 5.0 | 480 | 495 | 37.50 | 45.50 | 59.70 | 72.30 | 94.90 | 115.10 | 133.70 |
| 7.5 | 85 | 100 | 1.53 | 1.86 | 2.44 | 2.95 | 3.87 | 4.70 | 5.46 |
| 7.5 | 120 | 135 | 2.79 | 3.38 | 4.44 | 5.38 | 7.06 | 8.56 | 9.94 |
| **7.5** | **300** | **315** | **15.19** | **18.41** | **24.16** | **29.30** | **38.44** | **45.61** | **54.13** |
| 7.5 | 540 | 555 | 47.10 | 57.20 | 75.00 | 90.90 | 119.30 | 144.70 | 168.00 |
| 10.0 | 120 | 135 | 2.79 | 3.38 | 4.44 | 5.38 | 7.06 | 8.56 | 9.94 |
| 10.0 | 170 | 185 | 5.24 | 6.35 | 8.33 | 10.11 | 13.26 | 16.08 | 18.67 |
| **10.0** | **340** | **355** | **19.29** | **23.39** | **30.69** | **37.21** | **48.83** | **59.20** | **68.75** |
| 10.0 | 680 | 495 | 73.90 | 89.60 | 117.60 | 142.60 | 187.10 | 226.90 | 263.50 |
| 15.0 | 120 | 135 | 2.83 | 3.43 | 4.50 | 5.46 | 7.17 | 8.69 | 10.09 |
| 15.0 | 150 | 165 | 4.22 | 5.11 | 6.71 | 8.14 | 10.68 | 12.95 | 15.03 |
| 15.0 | 170 | 185 | 5.29 | 6.42 | 8.42 | 10.21 | 13.40 | 16.25 | 18.87 |
| 15.0 | 220 | 235 | 8.52 | 10.34 | 13.56 | 16.44 | 21.58 | 26.17 | 30.38 |
| 15.0 | 300 | 355 | 19.40 | 23.52 | 30.86 | 37.42 | 49.10 | 59.54 | 69.14 |
| **15.0** | **400** | **415** | **26.48** | **32.11** | **42.14** | **51.10** | **67.05** | **81.30** | **94.41** |
| 15.0 | 480 | 495 | 37.65 | 45.65 | 59.91 | 72.64 | 95.31 | 115.57 | 134.21 |
| 20.0 | 250 | 265 | 10.83 | 13.13 | 17.23 | 20.89 | 27.41 | 33.24 | 38.60 |
| 20.0 | 340 | 355 | 19.50 | 23.50 | 30.90 | 37.40 | 49.10 | 59.50 | 69.10 |
| **20.0** | **500** | **515** | **40.75** | **49.41** | **64.83** | **78.62** | **103.16** | **125.08** | **145.25** |
| 32.0 | 200 | 227 | 7.90 | 9.60 | 12.50 | 15.20 | 20.00 | 24.20 | 28.10 |
| 32.0 | 280 | 307 | 14.40 | 17.50 | 23.00 | 27.80 | 36.50 | 44.30 | 51.40 |
| **32.0** | **700** | **727** | **80.90** | **98.10** | **128.70** | **156.10** | **204.80** | **248.30** | **288.30** |
| 32.0 | 1220 | 1247 | 230.40 | 279.40 | 366.60 | 441.50 | 583.30 | 707.30 | 821.30 |

Notes: Dimensions in **bold** text are prefered lengths.

## Optimum Pull Out Values for Various Embedment Depths in Relation to Concrete Strength

**table 7**
Optimum Pull Out Values **Po** (tonnes) for Various Embedment Depths **E**

| Embedment E (mm) | Concrete Strength B | | | | | | |
|---|---|---|---|---|---|---|---|
| | 10 N/mm$^2$ | 15N/mm$^2$ | 20N/mm$^2$ | 30N/mm$^2$ | 40N/mm$^2$ | 50N/mm$^2$ | 60N/mm$^2$ |
| 45 | 0.4 | 0.5 | 0.6 | 0.8 | 1.0 | 1.1 | 1.2 |
| 50 | 0.5 | 0.6 | 0.7 | 1.0 | 1.2 | 1.4 | 1.5 |
| 55 | 0.6 | 0.7 | 0.9 | 1.2 | 1.4 | 1.7 | 1.9 |
| 60 | 0.7 | 0.9 | 1.1 | 1.4 | 1.7 | 2.0 | 2.2 |
| 65 | 0.8 | 1.0 | 1.2 | 1.6 | 2.0 | 2.3 | 2.6 |
| 70 | 0.9 | 1.2 | 1.4 | 1.9 | 2.3 | 2.7 | 3.0 |
| 75 | 1.0 | 1.4 | 1.7 | 2.2 | 2.6 | 3.1 | 3.5 |
| 80 | 1.2 | 1.6 | 1.9 | 2.5 | 3.0 | 3.5 | 3.9 |
| 85 | 1.3 | 1.8 | 2.1 | 2.8 | 3.4 | 3.9 | 4.5 |
| 90 | 1.5 | 2.0 | 2.4 | 3.1 | 3.8 | 4.4 | 5.0 |
| 95 | 1.7 | 2.2 | 2.7 | 3.5 | 4.2 | 4.9 | 5.6 |
| 100 | 1.9 | 2.4 | 3.0 | 3.9 | 4.7 | 5.5 | 6.2 |
| 105 | 2.0 | 2.7 | 3.3 | 4.3 | 5.2 | 6.0 | 6.8 |
| 110 | 2.2 | 2.9 | 3.6 | 4.7 | 5.7 | 6.6 | 7.5 |
| 115 | 2.5 | 3.2 | 3.9 | 5.1 | 6.2 | 7.2 | 8.2 |
| 120 | 2.7 | 3.5 | 4.3 | 5.6 | 6.8 | 7.9 | 8.9 |
| 125 | 2.9 | 3.8 | 4.6 | 6.1 | 7.3 | 8.5 | 9.6 |
| 130 | 3.1 | 4.1 | 5.0 | 6.5 | 7.9 | 9.2 | 10.4 |
| 135 | 3.4 | 4.4 | 5.4 | 7.1 | 8.6 | 9.9 | 11.2 |
| 140 | 3.6 | 4.8 | 5.8 | 7.6 | 9.2 | 10.7 | 12.1 |
| 145 | 3.9 | 5.1 | 6.2 | 8.1 | 9.9 | 11.5 | 13.0 |
| 150 | 4.2 | 5.5 | 6.6 | 8.7 | 10.6 | 12.3 | 13.9 |
| 155 | 4.5 | 5.9 | 7.1 | 9.3 | 11.3 | 13.1 | 14.8 |
| 160 | 4.8 | 6.2 | 7.6 | 9.9 | 12.0 | 14.0 | 15.8 |
| 165 | 5.1 | 6.6 | 8.0 | 10.5 | 12.8 | 14.9 | 16.8 |
| 170 | 5.4 | 7.0 | 8.5 | 11.2 | 13.6 | 15.8 | 17.8 |
| 175 | 5.7 | 7.5 | 9.0 | 11.9 | 14.4 | 16.7 | 18.9 |
| 180 | 6.0 | 7.9 | 9.6 | 12.6 | 15.2 | 17.7 | 20.0 |
| 185 | 6.4 | 8.3 | 10.1 | 13.3 | 16.1 | 18.7 | 21.1 |
| 190 | 6.7 | 8.8 | 10.7 | 14.0 | 17.0 | 19.7 | 22.3 |
| 195 | 7.1 | 9.3 | 11.2 | 14.7 | 17.9 | 20.7 | 23.4 |
| 200 | 7.4 | 9.7 | 11.8 | 15.5 | 18.8 | 21.8 | 24.7 |

## Edge Distances Affecting Pull Out Values

When an anchor is placed close to an edge and the minimum dimension of three times the anchor embedment **E** is not fulfilled, then reductions in pull out capacity occur. These reductions are based on the ratio of the actual edge distance available **Ed** to the anchor embedment **E**. The reduction factor **Ef** is obtained from Graph A from the value **Ed/E**.

This reduction should be considered for all edges adjacent to the anchor. The final reduction factor **Rf** is the product obtained from the four values of **Ef** for edges adjacent to the anchor. Please note that where the anchor is placed three or more times its embedment depth from an edge, the reduction factor **Ef** for that edge is always 1.

**Graph A**

Ed/E (y-axis)

Ef (x-axis)
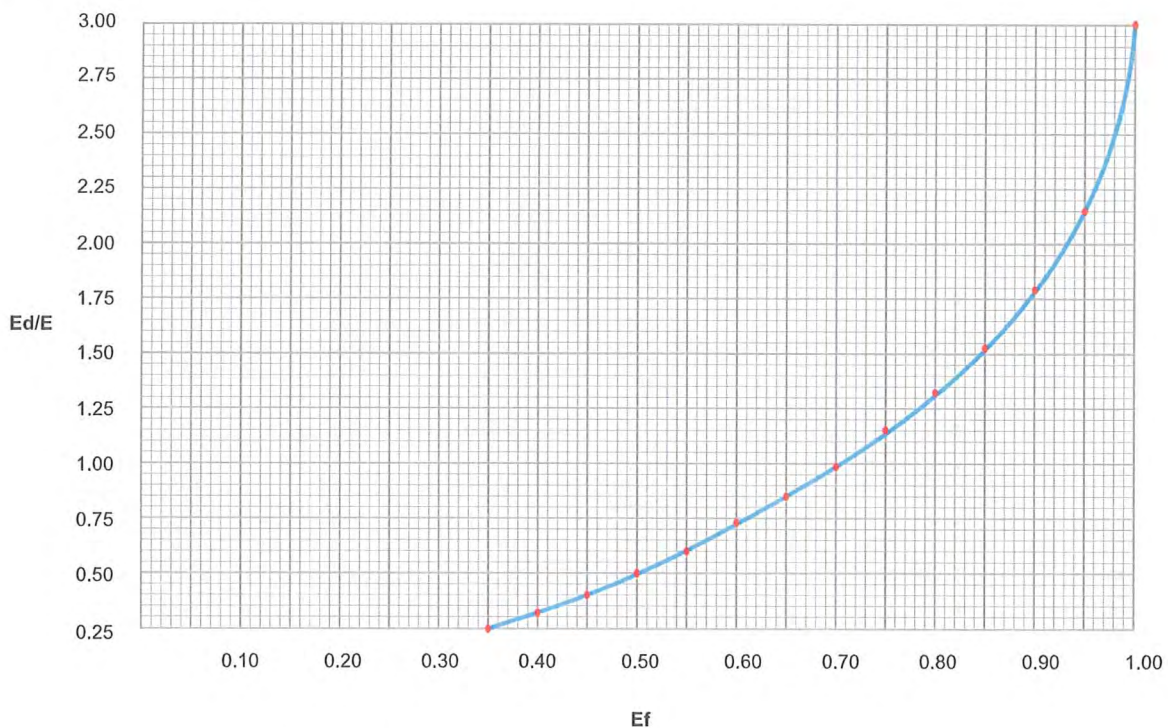
Values of **Ef** for values of $\dfrac{Ed}{E}$

Where **Ed** = Edge Distance
**E** = Embedment

**Notes:** When **Ed/E** <0.25 use Graph C

## Adjacent Anchors Affecting Pull Out Values

Where an anchor is placed a distance less than six times it's embedment $E$ from an adjacent anchor, similarly there are reductions in the pull out capacity of the concrete. The reduction factors $Sf$ are based on the ratio of $T/E$ and can be obtained from Graph B. please note that $T$ is half the distance between the two anchors.

They should represent a replacement of one or two of the edge distance factors $Ef$ in the previous section. The final reduction factor $Rf$ is obtained from the product of these four factors. Where any anchor is more than six times its embedded length from an adjacent anchor the value for $Sf$ in that direction is 1.

**Graph B**



Values of $Sf$ for values of $\dfrac{T}{E}$

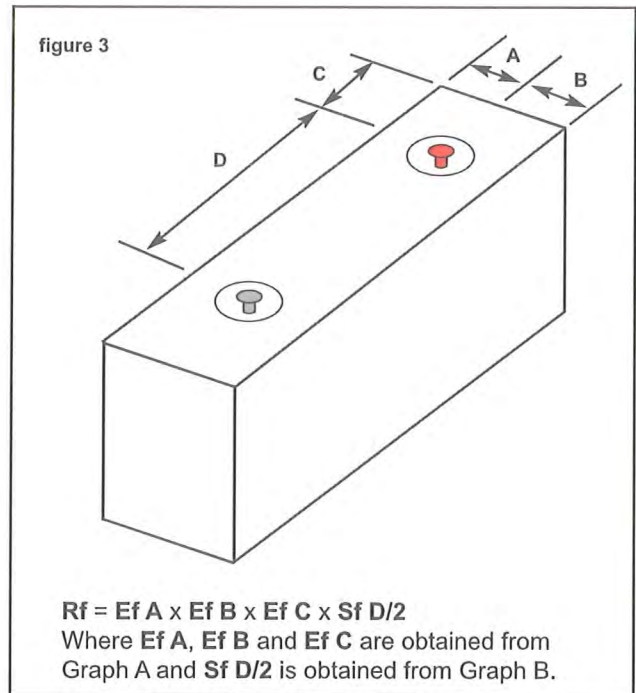Where $T$ = Half the distance Edge Distance
$E$ = Embedment
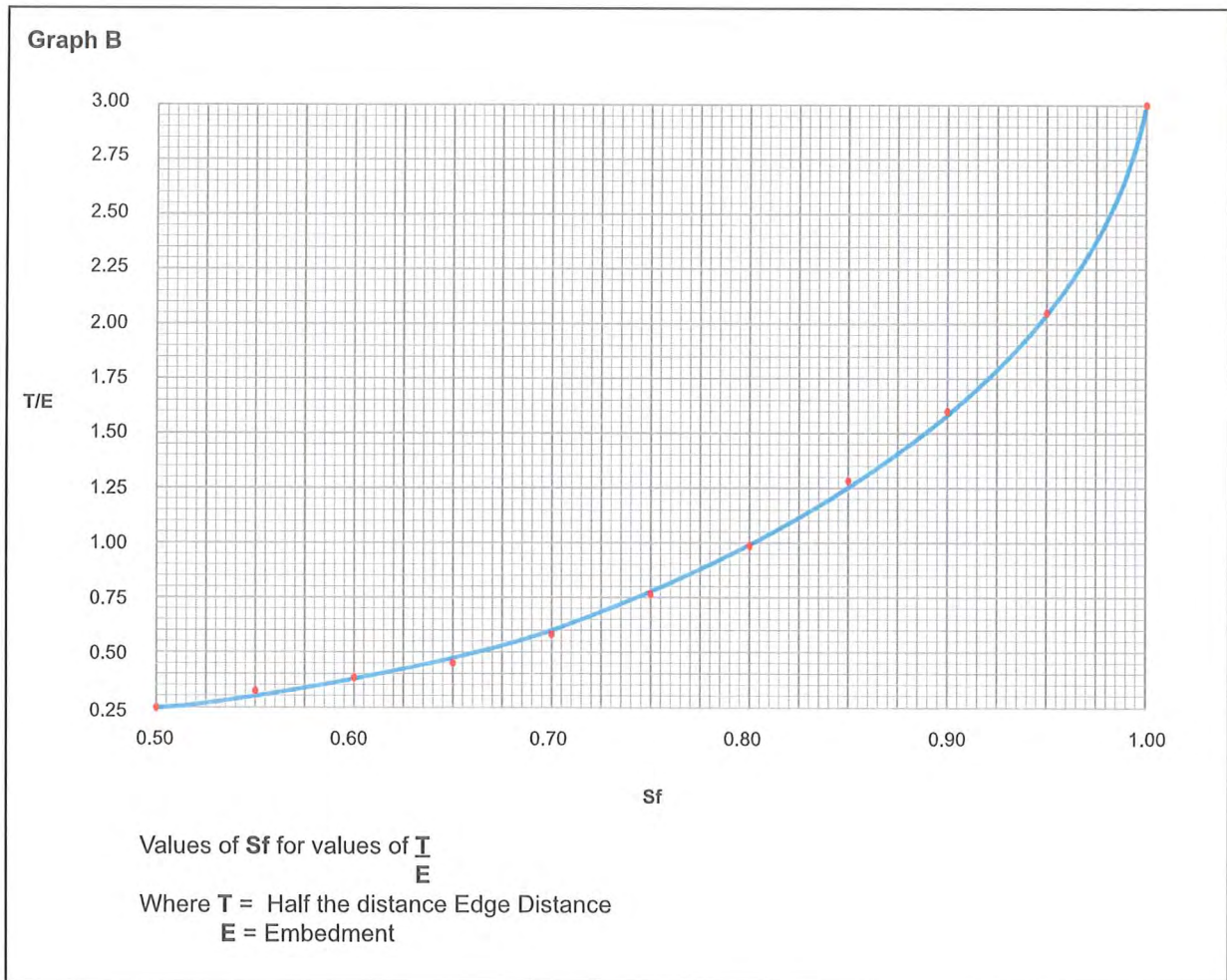
## Examples For Determining Reduction Factors

From the following three figures the reduction factor is calculated as follows.



figure 1

$Rf = Ef\ A \times Ef\ B \times Ef\ C \times Ef\ D$
Where **Ef A**, **Ef B**, **Ef C** and **Ef D** are obtained from Graph A.



figure 2

$Rf = Ef\ A \times Ef\ B \times Sf\ C/2 \times Sf\ D/2$
Where **Ef A** and **Ef B** are obtained from Graph A and **Sf C/2** and **Sf D/2** are obtained from Graph B.



figure 3

$Rf = Ef\ A \times Ef\ B \times Ef\ C \times Sf\ D/2$
Where **Ef A**, **Ef B** and **Ef C** are obtained from Graph A and **Sf D/2** is obtained from Graph B.
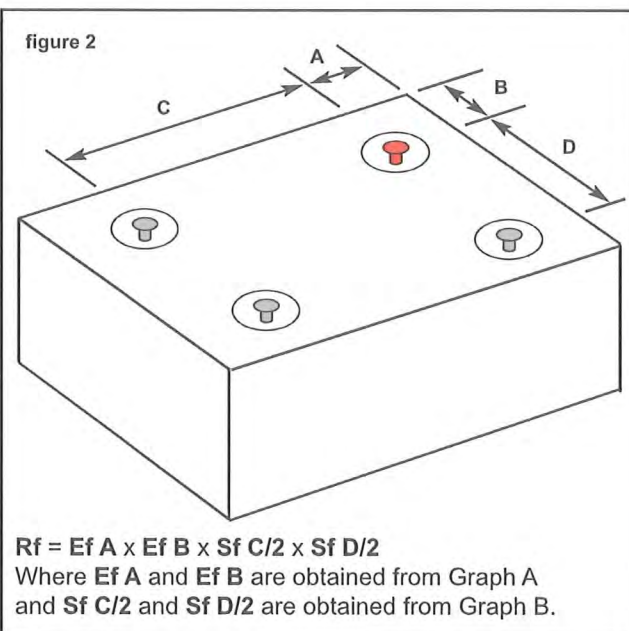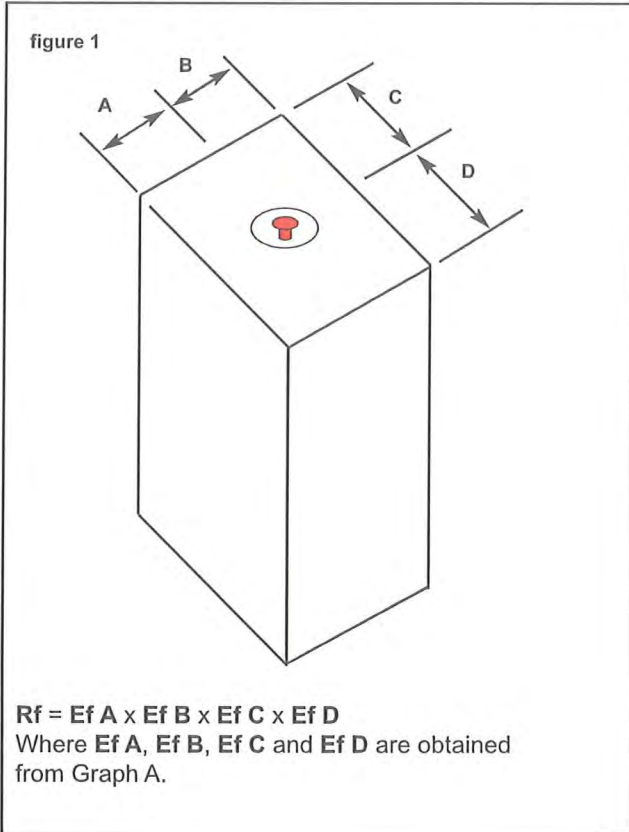
In any given direction where optimum spacing is not possible due to the dimensions of a unit, it is preferable to increase edge distances over centre to centre distances. In this instance allow one third of the space available, for edge distance to each anchor. The remaining third being the distance between the two anchors.

To calculate the size of anchor required, simply divide the load per anchor value **Fe** by the load reduction factor **Rf**. This will give us the minimum pull out capacity requirements for **Po** and should be compared with the values in tables 6 and 7, giving us the optimum anchor length and concrete strength. Alternately the **Po** value from tables 6 and 7 can be multiplied by the load reduction factor **Rf** until a suitable value for **Fe** is matched, though this is more a case of elimination.

### Reductions in Pull Out Values for Narrow Panels

Where anchors are to be used in very narrow panels (where the panel thickness is less than 50% of the proposed anchor embedment depth) further reductions must be applied to the values in tables 6 and 7. This reduction factor **X** can be obtained from Graph C and is a function of the wall thickness in relation to concrete strength. This factor is multiplied by the values for **Po** in tables 6 and 7 to give the optimum pull out strength of the anchor in that particular placement. With the anchor positioned in the centre of the narrow width, the ideal placement of the anchor for edge distance should be three times it's embedment **E** and six times it's embedment from any other anchor. If this criteria cannot be met then reductions in anchor pull out capacities should be calculated for the edge distance and centres of anchor as previously examined. Note, as we have already calculated the reduction in two directions for the narrow panel, we only need to look at two directions of reduction. This further reduction factor is applied to the reduced optimum pull out strength already calculated for the narrow panel. It is imperative that narrow units are not lifted below a concrete strength of 10 N/mm².

**Graph C**

Concrete Strength B (N/mm²)



Values of **X** for wall thickness and concrete strength **B**

**Notes**: d = wall thickness <E/2
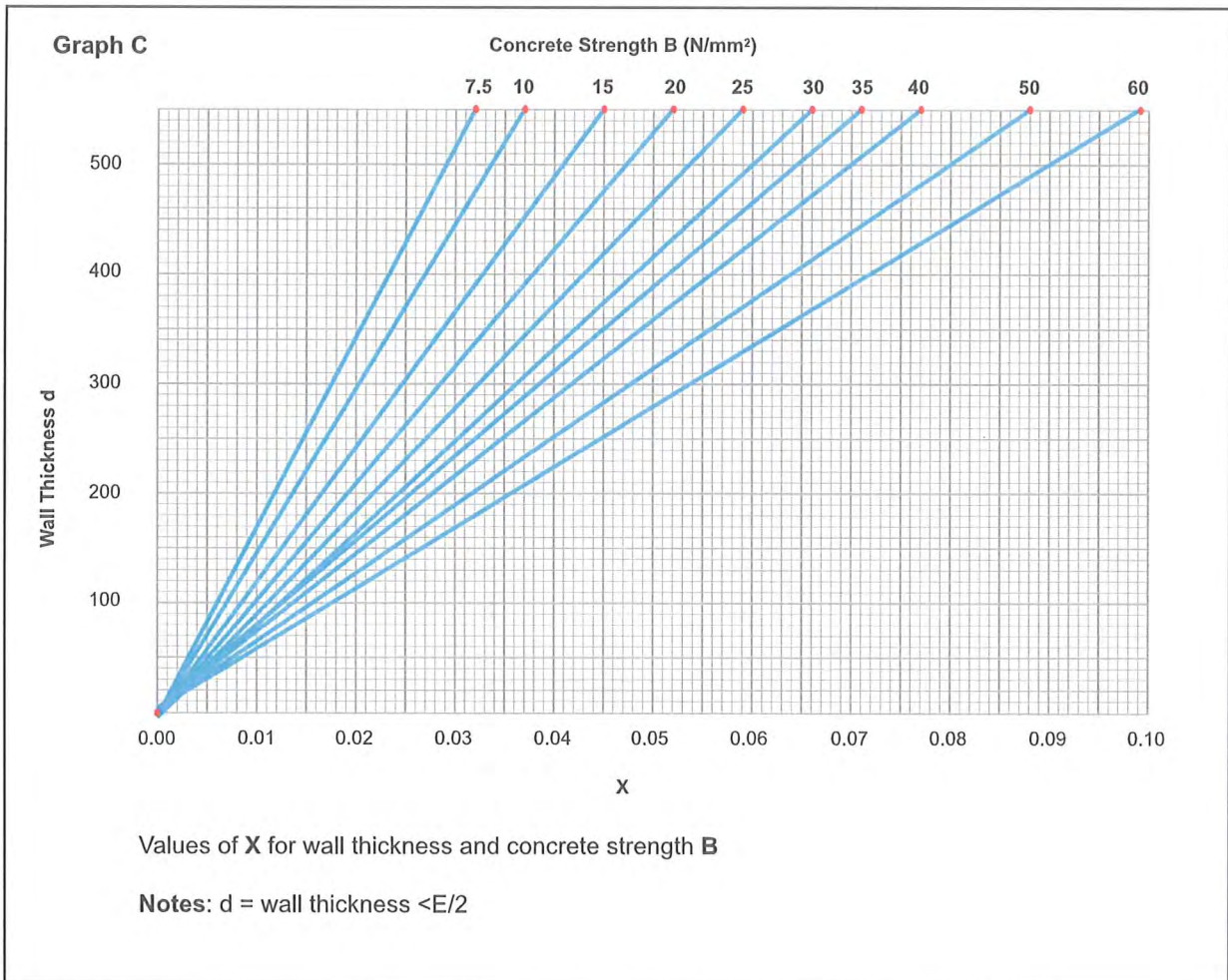
## Face Failure

Face failure can occur when an anchor is placed in a thin section of concrete. Loads exerted on the anchor can cause cracking or bursting of the concrete in the area closest to the base of the anchor, where the load is transferred into the concrete. In order to alleviate this, minimum edge distances as per table 8 should be observed. If these edge distances cannot be met then an alternative combination of anchor length and concrete strength corresponding to the available edge distance, should be chosen from table 9 (page 15). The face failure value must be higher than the required load per anchor **Fe** calculated previously.

### table 8
Face Failure Minimum Edge Distances

| Load Capacity (tonnes) | Minimum Edge Distance (mm) |
|---|---|
| 1.3 | 40 |
| 2.5 | 60 |
| 5.0 | 85 |
| 7.5 | 105 |
| 10.0 | 115 |
| 15.0 | 140 |
| 20.0 | 165 |
| 32.0 | 255 |

## Additional Reinforcement Requirements

Whilst the Pin Anchor system load values relate to unreinforced concrete, in certain instances where narrow panels are being turned from horizontal plane to the vertical plane, shear loads perpendicular to the axis of the anchor can result in the anchor tearing sideways out of the concrete. With this in mind it is necessary to introduce additional reinforcement. This can be straight or bent to lap into any existing mesh reinforcement in the panel. It should oppose the lifting forces and be fixed as close to the head of the Pin Anchor as practically possible. The length and diameter of the reinforcement should be in accordance with table 10.

### table 10
Additional Reinforcement for Tilting Narrow Panels

| Load Capacity (tonnes) | Load Capacity for Turning (tonnes) | Bar Dia. (mm) | Total Length (mm) |
|---|---|---|---|
| 1.3 | 0.65 | 8 | 500 |
| 2.5 | 1.25 | 10 | 600 |
| 5.0 | 2.50 | 16 | 975 |
| 7.5 | 3.75 | 20 | 1200 |
| 10.0 | 5.00 | 20 | 1200 |
| 15.0 | 7.50 | 25 | 1500 |
| 20.0 | 10.0 | 32 | 1925 |
| 32.0 | 16.0 | 40 | 2400 |

There is also a danger when tilting units with very small edge distances that the small area of concrete between the edge of the preformed pocket and the edge of the unit can break away due to loads induced on the concrete by the Pin Anchor Ring Clutch. If edge distances are not in accordance with the following table 11 then additional reinforcement as per sketch below should be utilised.

### table 11
Minimum Edge Distances and Additional Reinforcement for Tilting Thin Panels without Nib Damage

| Load Capacity (tonnes) | Minimum Edge Distance (mm) | Bar Diameter (mm) | Total Length (mm) |
|---|---|---|---|
| 1.3 | 60 | 8 | 800 |
| 2.5 | 80 | 10 | 1120 |
| 5.0 | 100 | 16 | 1600 |
| 7.5 | 130 | 20 | 1750 |
| 10.0 | 130 | 20 | 1750 |
| 15.0 | 180 | 25 | 2000 |
| 20.0 | 180 | 25 | 2000 |
| 32.0 | 250 | 32 | 2600 |
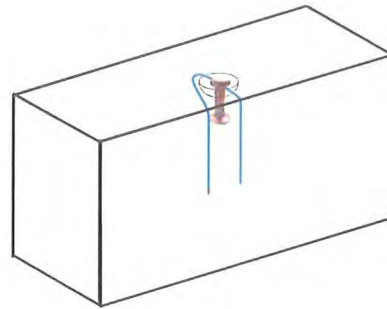


## Summary

When utilising the Pin Anchor system the following should be considered:

- The actual load on the anchor, taking into account all elements that will influence this load such as the number of anchors, their placement, sling angles, demoulding forces and any dynamic loading forces.
- The load rating and length of the Pin Anchor. Where possible a prefered length Pin Anchor should be selected and placed with optimum edge distances and anchor spacings.
- The reduction in pull out strengths in flat panels due to reduced edge distances and anchor spacings.
- The reduction in pull out capacity for narrow elements.
- The possibility of face failure with narrow elements.
- Additional reinforcement requirements when tilting narrow units.

**table 9**
Face Failure Values for Thin Panels

| Load Rating (tonnes) | Edge Distance (mm) | Concrete Strength B | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 10 N/mm² | 15 N/mm² | 20 N/mm² | 30 N/mm² | 10 N/mm² | 15 N/mm² | 20 N/mm² |
| | | Anchor Length 120mm | | | | Anchor Length 240mm | | |
| 1.3 | 25 | 0.58 | 0.79 | 0.99 | 1.35 | 0.66 | 0.90 | 1.11 |
| 1.3 | 30 | 0.74 | 1.00 | 1.24 | - | 0.82 | 1.10 | - |
| 1.3 | 35 | 0.92 | 1.24 | - | - | 1.00 | - | - |
| 1.3 | 40 | 1.14 | - | - | - | 1.22 | - | - |
| | | Anchor Length 170mm | | | | Anchor Length 280mm | | |
| 2.5 | 30 | 0.96 | 1.31 | 1.65 | 2.27 | 1.06 | 1.45 | 1.81 |
| 2.5 | 35 | 1.15 | 1.56 | 1.94 | 2.66 | 1.25 | 1.69 | 2.11 |
| 2.5 | 40 | 1.36 | 1.84 | 2.29 | - | 1.46 | 1.98 | 2.45 |
| 2.5 | 45 | 1.60 | 2.16 | - | - | 1.71 | 2.29 | - |
| 2.5 | 50 | 1.87 | 2.52 | - | - | 1.98 | - | - |
| 2.5 | 55 | 2.17 | - | - | - | 2.28 | - | - |
| | | Anchor Length 240mm | | | | Anchor Length 480mm | | |
| 5.0 | 50 | 2.34 | 3.19 | 3.97 | 5.44 | 2.66 | 3.61 | 4.48 |
| 5.0 | 60 | 2.97 | 4.01 | 4.98 | - | 3.29 | 4.43 | 5.48 |
| 5.0 | 70 | 3.71 | 4.99 | - | - | 4.03 | 5.41 | - |
| 5.0 | 80 | 4.57 | - | - | - | 4.89 | - | - |
| | | Anchor Length 300mm | | | | Anchor Length 540mm | | |
| 7.5 | 50 | 2.75 | 3.77 | 4.73 | 6.54 | 3.13 | 4.28 | 5.34 |
| 7.5 | 60 | 3.38 | 4.60 | 5.74 | 7.86 | 3.77 | 5.11 | 6.35 |
| 7.5 | 70 | 4.13 | 5.58 | 6.92 | 9.41 | 4.51 | 6.08 | 7.53 |
| 7.5 | 80 | 4.98 | 6.70 | - | - | 5.37 | 7.21 | - |
| 7.5 | 90 | 5.95 | - | - | - | 6.35 | - | - |
| 7.5 | 100 | 7.04 | - | - | - | 7.42 | - | - |
| | | Anchor Length 340mm | | | | Anchor Length 680mm | | |
| 10 | 50 | 3.22 | 4.45 | 5.61 | 7.81 | 3.85 | 5.28 | 6.62 |
| 10 | 60 | 3.85 | 5.28 | 6.61 | 9.13 | 4.49 | 6.11 | 7.63 |
| 10 | 70 | 4.60 | 6.26 | 7.80 | - | 5.23 | 7.09 | 8.81 |
| 10 | 80 | 5.46 | 7.38 | 9.17 | - | 6.09 | 8.22 | - |
| 10 | 90 | 6.43 | 8.66 | - | - | 7.06 | 9.49 | - |
| 10 | 100 | 7.51 | - | - | - | 8.15 | - | - |
| 10 | 110 | 8.71 | - | - | - | 9.35 | - | - |
| | | Anchor Length 400mm | | | | Anchor Length 840mm | | |
| 15 | 70 | 5.39 | 7.40 | 9.30 | 12.86 | 6.39 | 8.71 | 10.88 |
| 15 | 80 | 6.25 | 8.53 | 10.67 | 14.66 | 7.25 | 9.84 | 12.25 |
| 15 | 90 | 7.23 | 9.81 | 12.22 | - | 8.22 | 11.12 | 13.81 |
| 15 | 100 | 8.31 | 11.24 | 13.95 | - | 9.31 | 12.55 | - |
| 15 | 110 | 9.51 | 12.82 | - | - | 10.51 | 14.12 | - |
| 15 | 120 | 10.83 | 14.54 | - | - | 11.83 | - | - |
| 15 | 130 | 12.25 | - | - | - | 13.25 | - | - |
| 15 | 140 | 13.79 | - | - | - | 14.79 | - | - |
| | | Anchor Length 500mm | | | | Anchor Length 1000mm | | |
| 20 | 80 | 7.20 | 9.88 | 12.40 | 17.19 | 8.50 | 11.58 | 14.47 |
| 20 | 100 | 9.26 | 12.59 | 15.68 | - | 10.56 | 14.30 | 17.75 |
| 20 | 120 | 11.78 | 15.89 | 19.69 | - | 13.08 | 17.60 | - |
| 20 | 140 | 14.75 | 19.79 | - | - | 16.05 | - | - |
| 20 | 160 | 18.71 | - | - | - | 19.47 | - | - |
| | | Anchor Length 700mm | | | | Anchor Length 1200mm | | |
| 32 | 80 | 9.67 | 13.41 | 16.95 | 23.66 | 11.34 | 15.60 | 19.60 |
| 32 | 100 | 11.75 | 16.13 | 20.25 | 28.00 | 14.42 | 18.32 | 22.90 |
| 32 | 120 | 14.28 | 19.45 | 24.27 | - | 15.95 | 21.64 | 26.93 |
| 32 | 140 | 17.28 | 23.36 | 29.01 | - | 18.93 | 25.55 | 31.67 |
| 32 | 160 | 20.69 | 27.86 | - | - | 22.36 | 30.05 | - |
| 32 | 180 | 24.57 | - | - | - | 26.24 | - | - |
| 32 | 200 | 28.91 | - | - | - | - | - | - |

## Lifting Pipe Units

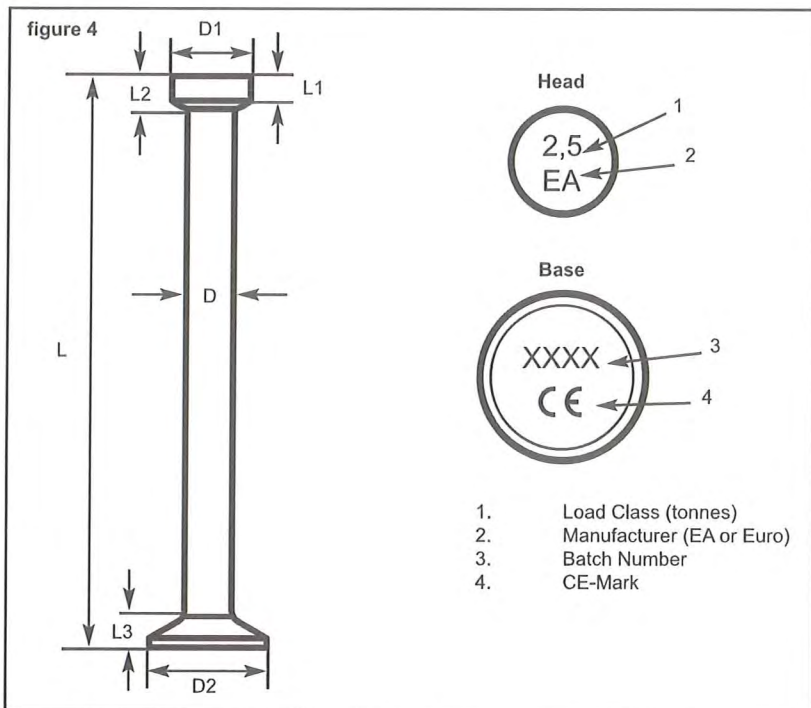Where the Pin Anchor system is utilised in concrete pipe elements the load values and concrete strengths as per table 12 should be referred to. The anchors must be placed along the central axis of the pipe and must have an edge distance **Ed** equal to 3 times the anchor embedment for the size range utilised, and 6 times the embedment for anchor spacing.

**table 12**
Permissible Loads for Various Anchor Lengths, Concrete Strengths and Pipe Diameters (tonnes)

| Pipe Diameter (mm) | Anchor length (mm) | Permissible Load (tonnes) and Concrete Strength B | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- |
| | | 25 N/mm² | 35 N/mm² | 45 N/mm² | 55 N/mm² | 60 N/mm² | 70 N/mm² |
| >300 | 40 | 0.72 | 0.91 | 1.07 | 1.23 | 1.29 | 1.43 |
| | 45 | 0.86 | 1.08 | 1.28 | 1.47 | 1.54 | 1.71 |
| | 50 | 1.01 | 1.26 | 1.49 | 1.71 | 1.81 | 2.01 |
| >500 | 40 | 0.77 | 0.97 | 1.15 | 1.31 | 1.38 | 1.53 |
| | 45 | 0.92 | 1.16 | 1.37 | 1.57 | 1.65 | 1.83 |
| | 50 | 1.08 | 1.35 | 1.60 | 1.83 | 1.94 | 2.15 |
| | 55 | 1.26 | 1.57 | 1.86 | 2.13 | 2.27 | 2.51 |
| >700 | 50 | 1.13 | 1.41 | 1.67 | 1.91 | 2.03 | 2.25 |
| | 55 | 1.31 | 1.64 | 1.94 | 2.22 | 2.36 | 2.61 |
| | 65 | 1.70 | 2.14 | 2.53 | 2.89 | 3.05 | 3.39 |
| | 75 | 2.15 | 2.69 | 3.18 | 3.64 | 3.86 | 4.28 |
| >900 | 75 | 2.41 | 3.02 | 3.57 | 4.09 | 4.33 | 4.60 |
| | 95 | 3.50 | 4.39 | 5.19 | 5.94 | 6.29 | 6.97 |
| | 120 | 5.12 | 6.42 | 7.59 | 8.69 | 9.20 | 10.20 |
| >1100 | 75 | 2.47 | 3.09 | 3.66 | 4.19 | 4.44 | 4.92 |
| | 95 | 3.60 | 4.50 | 5.33 | 6.10 | 6.47 | 7.17 |
| | 120 | 5.27 | 6.60 | 7.81 | 8.94 | 9.47 | 10.50 |
| >1400 | 120 | 5.44 | 6.82 | 8.07 | 9.23 | 9.78 | 10.84 |
| >1800 | 170 | 10.12 | 12.68 | 15.01 | 17.17 | 18.19 | 20.17 |

# Pin Anchors



figure 4

Head

2,5
EA

1.
2.

Base

XXXX
CE

3
4

1. Load Class (tonnes)
2. Manufacturer (EA or Euro)
3. Batch Number
4. CE-Mark

These anchors are forged from round mild steel. They are offered in either mild steel, hot dip galvanised or stainless steel (grade 304) finish. Each item is clearly marked with Euro Accessories branding, it's maximum safe working load, CE marking and batch number. Please refer to table 13 and figure 4 for relevant details.

The capability of the surrounding concrete to withstand lifting loads should always be considered before lifting commences.

**table 13**
Pin Anchor Dimensions

| Load Capacity (tonnes) | Anchor Length L (mm) | D (mm) | D1 (mm) | D2 (mm) | L1 (mm) | L2 (mm) | L3 (mm) |
|---|---|---|---|---|---|---|---|
| 1.3 | 55 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 1.3 | 40 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 1.3 | 50 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 1.3 | 55 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 1.3 | 65 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 1.3 | 85 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 1.3 | 120 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 1.3 | 240 | 10 | 18 | 25 | 5.0 | 8.0 | 5.0 |
| 2.5 | 45 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 55 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 65 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 70 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 85 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 100 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 120 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 140 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 170 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 180 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 240 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 2.5 | 280 | 14 | 25 | 35 | 7.0 | 10.0 | 7.0 |
| 5.0 | 50 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 65 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 80 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 85 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 95 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 100 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 110 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 120 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |
| 5.0 | 140 | 20 | 36 | 50 | 8.5 | 13.0 | 10.0 |