**Paper-1**

**Uplift capacity of horizontal anchors**

KS Subba Rao

Professor Emeritus

Department of Civil Engineering./Project management group,

Indian Institute of Science

Bangalore-560012,

Karnataka state, India

Mobile: +919448277 494

R N Herkal

Principal, Basaveshwar Engineering College

Bagalkot: 587102,

Karnataka State, India

Phone: +918354 234060 (off.), +918354 235679 (Res.)

Cell: +919448119490

Fax: +918354 234204

E-mail: raghuherkal@yahoo.com

M Prakash

Research Scholar,

Department of civil engineering,

Basaveshwar Engineering College,

Bagalkot,-587102

Karnataka State, India

Mobile +918971195040

Fax: +918232 222075

E-mail: mprakash.jan02@gmail.com

**Abstract:**

Horizontal plate anchors are widely used in civil engineering construction to resist tension loads. In this paper the pullout tests are performed using model anchor plates of square (7.5 cm × 7.5 cm), strip anchors (3.8 cm × 33 cm) circular (10.4 cm diameter) and rectangular (7.5 cm × 11.25 cm) in a test tank using sand in medium dense and dense state. The depth to width ratio is varied from 2 to 5 and the results are compared with the theoretical values and as well as experiment data available in literature. The pullout resistance increases with the increase in embedment ratio (H/B ratio) and the failure occurred at a very low strain of less than 6%.

Key words: Anchors, Medium dense and dense sand, Rain-technique, Pullout resistance

Breakout factor, Shape factor

**INTRODUCTION:**

Numerous articles have appeared in the literature on the subject of the breakout resistance of plate anchors in sand. One of earlier studies is attributed to Majer (1955). He assumed a vertical slip surface above the anchor plus the shearing resistance along the perimeter of the vertical slip surface. Balla (1961) developed theoretical equation to evaluate breakout resistance by assuming tangential curve, starting with a vertical tangent to base of anchor slab and curving outwards from the vertical axis to meet the ground surface at an angle of (45°-φ/2). Sutherland (1982), Meyerhof and Adams (1968) assuming pyramidal shaped failure surface developed equations to predict the pullout capacity of strip anchor and anchor plate Das and Seeley (1975) having different shapes by introducing shape factor. Later, Sutherland (1982), Vermeer and Sutziadi (1985) assumed inverted truncated cone model. Subba Rao and Jyanth kumar (1992) developed theoretical equation by assuming tangential curved slip surface which meets the ground surface at an angle of (45° - φ/2). This theory satisfies Meyerhof and Adams (1968) equation.

Most of these theories have dealt with horizontal or vertical anchors and have been based on the results of tests on small scale models in the laboratory which may be subjected to the scale effects. The capacity of plate anchors in sand is a function of several factors viz. sand type and density, plate size and shape, depth to width ratio of the plate, anchor inclination etc. Individual investigations reported in the literature have usually considered the effects of a limited number of these factors. To develop an integrated approach often looks difficult to comprehend. In the present study a series of pullout tests are performed on model anchor plate and attempts are made to develop a theoretical model to predict the pullout resistance of plate anchors. An attempt was also made to validate this theoretical model with the available data of similar tests done by various authors.

**EXPERIMENTAL PROCEDURE**

Pullout tests are conducted in a hopper steel tank having inside dimension of 100 cm × 100 cm × 100 cm at bottom, tapering to a depth of 120 cm as shown in figure 1. Using model strip anchor plate (3.8 cm × 33 cm ), circular anchor plate 10.4 cm diameter and square anchor plate (7.5 cm × 7.5 cm) and rectangular anchor plate (7.5 cm × 11.25 cm). The soil used for the tests is air dried uniformly graded sand passing through 2.38 mm I.S. sieve. The pullout tests are conducted in medium dense (Dr = 65%) and dense sand (Dr = 85%) states of compaction. The desired compaction was achieved by raining technique method. For medium dense state of compaction, the sand is poured from a height of 44 cm using a hopper and density achieved is 15.9 kN/m3. For dense condition, the sand is poured from a height of 64 cm and density achieved is 16.3 kN/ m3. The general arrangement of the experimental setup is illustrated in Figure.1. The properties of sand used are given in Table 1.

The depth of anchor is varied from 2B to 5B, where B is the width of square / rectangular anchor plate and diameter for circular anchor plate. The pullout tests are performed at a constant pullout rate of 0.315 mm/min, the uplift force is measured by using tension proving ring of 2500 N capacity with a least count of 1.67 N for medium dense sand. A higher capacity tension proving ring of 5000 N is used for dense sand state. The displacements are measured using a displacement dial gauge mounted on an independent datum bar and connected to the tie rod. The anchor plates used are made up of mild steel plate of thickness 6 mm. Failure surface is observed by putting a thin layer of lime powder at an interval of 50 mm depth, in both the states of sand. In the experiments mentioned above the pullout resistance measured is normally expressed in terms of pullout load. In the literature review, it is observed that several authors define pullout load in different ways. In the present study the ultimate load is considered as the pullout load (Pull out load Pu is the maximum load obtained while performing the pullout test). The properties of sand used are given in Table 1. The pullout loads observed for different anchors in medium dense and dense states of sand are presented in Table 2.

**Breakout factor (Nu):**

Pullout load is converted into a non dimensional parameter called as breakout factor, Nu, which is the ratio of ultimate pullout load of any type of anchor (eg: strip anchor) plate to the product of the cross sectional area (A) of the plate, the unit weight of the sand (γ) and the embedment depth (H) i.e.

Breakout factor,  *Nu = Pu/(A γH)* (1)

Breakout factor is expressed as a non dimensional parameter. Breakout factors are calculated using the equation (1) and are presented in the Table:3.

**Breakout factor of strip anchor:**

The main purpose of prediction of breakout factor is to facilitate the determination of pullout load by field engineers and practicing/design engineers for any required embedment ratio (H/B) and type and depth of footing.

Figure.2 shows the breakout factor vs. embedment ratio of strip anchor for medium dense and dense sand. The data of the various authors collected from the literature are shown along with the data obtained from the present investigation. The following equation has been developed for the experimental data of the authors, using statistical analysis.

Table3 show the breakout factor values of strip anchor in medium dense and dense sand respectively for the various embedment ratios adopted in the present study. The results of the similar tests from the literature are also shown for comparison. The statistical analysis of the present data gives the following relationship between breakout factor and embedment ratio.

Nu = 1 +1.09 (*H*/*B*) tan φ ( 2 )

Where Nu – Breakout factor, *H/B* – Embedment ratio, φ – angle of internal friction. Table 4 gives the comparison of pullout load (Newton) for strip anchor.

**Breakout factor for square anchor and circular anchor:**

Table 5 and Table 6 show the breakout factor values of square anchor in medium dense and dense sand respectively for the various embedment ratios. The results of the similar tests from the literature are also shown for comparison. Similarly, Table 7 and Table 8 show the breakout factor values of circular anchor in medium dense and dense sand respectively for the various embedment ratios adopted in the present study. The results of the similar tests from the literature are also presented for comparison data points of the various authors from the literature are shown along with the data points obtained in the present study. The following equation has been obtained for the curve fitted to the data points of the authors using statistical analysis.

*Nu*= 1 +2.94 (*H*//*B*) tan φ+0.15 (*H*//*B*)2 tan2 φ (3)

**Shape factor (s ) :**

Similarly Shape factor (s), a non dimensional parameter is defined as the ratio of ultimate pullout load of isolated anchor plate (square or circular or rectangular) to the ultimate pull load of continuous anchor (strip) plate. i.e

s = *Nu* (square anchor plate)/ *Nu* (strip anchor plate)

Using Eq (2) for a strip anchor, the pullout capacity of a square anchor or circular or rectangular anchor may be defined in terms of a shape factor ‘s’.

Tables 9(a) and 9 (b), Tables 10(a) and 10(b), Tables 11(a) and 11(b) show the shape factor values of square anchor, rectangular anchor and circular anchor in medium dense and dense sand are shown in the form of *L/B* log(*H* /*B*) tanφfor the various embedment ratios adopted in the present study. The results of the similar tests from the literature are also shown for a comparison. The following equation has been obtained for the curve fitted to the data of the authors using statistical analysis.

s = 1 + 3.7*(B/L)* log (*H* /*B*)tan φ - 1.15 *(B/L)2* [log (*H* /*B*)]2 tan2 φ (4)

Figure .4 shows the plot of shape factor values of isolated anchors (square, rectangular and circular) at various embedment in medium dense and dense sand. The data points of the various authors from the literature are shown along with the data points obtained in the present study. The shape factor is plotted as a function of (B/L) [log (*H* /B)] tanφ.

**RESULTS AND DISCUSSION:**

In the medium dense and dense sand used, it is observed, the rupture surface developed covers larger area in dense sand as compared to the rupture surface developed in medium dense sand in the pullout test conducted which results in higher pullout load due to development of more shear strength.

On account of more deposit of sand at greater embedment ratio (*H /B*), higher the pullout load with increase in embedment ratio and higher relative density of sand.

Both the surface area of circular and rectangular anchor plate being equal, the pullout capacity of circular anchor is more for the particular embedment ratio and relative density of sand, which will be due to development of more shear strength on the shape of failure plane of circular anchor.

The percent movement (δ/*B* %) will be higher as *H* /*B* is more for higher relative density of sand.

As the critical depth given by Meyerhof and Adams (1968) will be true with increase in angle of internal friction of sand, it will also take care of the size and shape of anchor plate and embedment ratio.

Since these tests are tension tests, the pullout capacity predicted by theoretical analysis will be thrice the pullout loads obtained from the laboratory tests. Hence suitable factor of safety is to be introduced in theoretical analysis.

The present proposed predictive equation gives more reliable pullout capacity of anchors both in medium dense and dense sand.

Lower the embedment ratio and smaller size of anchor plate results in improper calculation of non-dimensional break-out and shape factor.

**CONCLUSIONS:**

1. Pullout capacity increases with increase in embedment ratio.
2. Pullout capacity increases with increase in relative density of sand.
3. For a particular embedment ratio and relative density, the pullout capacity of both square and circular anchor plates have the same breakout factor. (the breakout factor *(Nu)* of both strip anchor and square and circular anchors is obtained using statistical analysis)
4. The shape factor ‘s’ is evaluated.

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Table-1.Properties of sand

|  |  |
| --- | --- |
| Properties | Value |
| Particle Size | |
| Gravel | 0.00% |
| Sand | 99.75% |
| Silt and clay | 0.25% |
| Uniformity coefficient | 1.67 |
| Coefficient of curvature | 1.29 |
| Effective size | 0.30 mm |
| Relative density (Dr) | |
| In medium dense state | Dr = 65%, *γ* = 15.9 kN/m3 Φ = 43°.5 |
| In dense state | Dr = 85% *γ* = 16.3 kN/m3 Φ = 46° |

Table-2 : Values of pullout load, in Newton

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl. No. | Embedment Ratio (H/B) | 2 | | 3 | | 4 | | 5 | | 1  Remarks |
| Type of Anchors | Relative Density (Dr) in percentage | | | | | | | |
| 65% | 85% | 65% | 85% | 65% | 85% | 65% | 85% |
| I | Strip  3.8 cm × 33 cm | 44 | 53 | 81 | 112 | 156 | 166 | 268 | 273 | For Dr = 65%  *γ* = 15.9 kN/m3  φ = 43.5°  For Dr = 85%  *γ* = 6.3 kN/m3  φ = 46° |
| II | Square  7.5 cm × 7.5 cm | 72 | 121 | 206 | 269 | 330 | - | 686 | 809 |
| III | Circular  10.4 cm dia. | - | - | 288 | 481 | 608 | 735 | 835 | 1265 |
| IV | Rectangular  7.5 cm × 11.25 cm | 73 | 160 | 213.5 | 282 | - | - | 726 | 821 |

Table 3 Experiment Breakout factor (non-dimension ) values of Strip anchor

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sl. N | Authors | Embedment Ratio (H/B) | | | |
| 2 | 3 | 4 | 5 |
| 1 | Present Study (Experiment) (L/B = 8.6)DR=65%,  φ = 43.5° Dr= 85%, φ = 46° | 2.89  3.40 | 3.56  4.79 | 5.14  5.34 | 7.00  7.03 |
| 2 | Vermeer and Sutjiadi (1985), φ = 33° | 3.2 | 4.25 | 5.32 | - |
| 3 | Sarac (1975), φ = 37.5° | 2.33 | 2.87 | - | - |
| 4 | Rowe and Davis (1982) (L/B = 8.75), φ = 32° | 2.65 | 2.79 | 3.14 | 4.07 |
| 5 | Murray & Geddes(1987) (L/B = 10)  Dr = 42%, φ = 36°  Dr = 85.9%, φ = 44° (Rough plate)  Dr = 85.9%, φ = 44° (smooth plate) | 1.78  3.77  3.06 | 2.89  5.00  4.35 | 3.55  4.97  - | 4.44  5.00  - |
| 6 | Dickin (1988) (L/B = 8)Dr = 76%, φ = 38° | 3.10 | 3.82 | - | 6 |
| 7 | Basudhar and Singh (1994) (L/B = 8.75) φ = 32° | - | 2.85 | 3.45 | 4.15 |

Table: 4 Comparison of pullout load (Newton) for strip anchor

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| H/B  Pullout  Authors  N. | Relative density 65%elative **Density 65%** | | | | |
| 2 | 3 | 4 | 5 | |
| Present experiment | 44 | 81 | 156 | 268 | |
| Meyer of & Adams (1968)  Theory | 42.5 | 84 | 140 | 208 |
| Authors equation 2 | 46 | 95 | 155 | 231 |

Table 5 Breakout factor(non-dimensional) values of square anchor in medium dense and (φ = 43.5°)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment Ratio (H/B) | Authors | | Meyer of and Adams (1968) | Murray and Geddes  (1981) | Oveson (1981) | | Frydman and Shaham  (1990) | Das and Seeley  (1981) | Clemeence  and  Vesseart  (1977) | Vermeer and Sutjiadi (1985) |
| Expt. | Pred. | Pred. | Pred. | Expt. | Pred. | Pred. | Pred. | Pred. | Pred. |
| i | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1.51 | 1 | 1 | 1 |
| ii | 1 | -- | 3.93 | 3.62 | 3.84 | -- | 3.52 | 2.43 | 2.7 | 4.03 | 3.75 |
| iii | 2 | 5.4 | 5.14 | 7.89 | 8.57 | 8.13 | 8.13 | 6.43 | 5.98 | 8.25 | 6.51 |
| iv | 3 | 10.23 | 10.32 | 13.79 | 15.18 | 17.3 | 14.10 | 10.12 | 10.85 | 13.15 | 9.26 |
| v | 4 | -- | 14.32 | 21.34 | 23.68 | 19.6 | 21.16 | 14.02 | 17.30 | 20.26 | 20.01 |
| vi | 5 | 20.43 | 18.33 | 30.53 | 34.07 | -- | 29.17 | 18.11 | 25.35 | 28.04 | 14.77 |

Table 6 Breakout factor(non-dimensional ) values of square anchor in dense sand (φ = 46°)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment Ratio (H/B) | Authors | | Meyer of and Adams (1968) | Murray and  Geddes (1981) | | Oveson  (1981) | Frydman and Shaham(1989) | Das and Seeley(1975) | Clemeence and Vesseart (1977) | Vermeer and Sutjiadi (1985) |
| Expt. | Pred. | Pred. | Pred. | Expt. | Pred. | Pred. | Pred. | Pred. | Pred. |
| i | 0 | - | 1 | 1 | 1 | 1 | 1 | 1.51 | 1 | 1 | 1 |
| ii | 1 | - | 4.2 | 4.02 | - | 4.19 | 3.89 | 3.07 | 4.02 | 4.28 | 3.88 |
| iii | 2 | 8.82 | 7.73 | 9.13 | 8.33 | 11.70 | 9.18 | 6.81 | 9.13 | 8.19 | 6.76 |
| iv | 3 | 13.06 | 11.68 | 16.34 | 11.64 | 17.32 | 16.04 | 10.80 | 13.4 | 14.9 | 9.63 |
| v | 4 | - | 15.74 | 25.66 | 16.66 | 27.25 | 24.15 | 15.04 | 21.72 | 22.24 | 12.51 |
| vi | 5 | 23.53 | 20.25 | 37.07 | 23.4 | 39.43 | 33.35 | 19.48 | 32.15 | 30.94 | 15.39 |

Table :7 Breakout factor(non-dimensional ) values of circular anchor in medium dense sand (φ = 43.5°)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment Ratio (H/B) | Authors | Mors (1965) | Suherland  (1965 & 1988) | Downs &  Chiurzzi (1966) | Kananyan (1966) | Dickin & Leung (1970) | Seedy (1971) | Oveson (1981) | Murray & Geddes (1987) |
| Expt. | Expt. | Expt. | Pred. | Pred. | Expt. | Expt. | Expt. | Expt. |
| i | 3 | 6.83 | 7.10 | 8.70 | 7.25 | 9.0 | 7.0 | 8.0 | 7.30 | 5.73 |
| i i | 4 | 10.82 | - | 8.80 | - | - | 11.36 | - | - | 5.57 |
| iii | 5 | 11.88 | - | 12.20 | - | - | 12.91 | - | - | 9.11 |

Table 8 Breakout factor (non-dimensional ) values of circular anchor in medium dense sand (φ = 46°)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment Ratio (H/B) | Authors | Mors  (1965) | Suherland  (1965 & 1988 ) | Baker & Kondner  (1966) | Balla (1961) | Clemeence and Vesseart (1977) | Kananyan (1966) |
| Expt. | Expt. | Expt. | Pred. | Expt. | Pred. | Pred. |
| i | 3 | 9.98 | 10.0 | 9.75 | 12.2 | 10.82 | 12.30 | 9 |
| ii | 4 | 12.77 | - | 13.25 | - | - | - | - |
| iii | 5 | 17.57 | - | 18.75 | 33.30 | - | - | - |

Table 8 (Continued ) Breakout factor(non-dimensional ) values of circular anchor in medium dense sand (φ=46°)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment Ratio (H/B) | Dickin (1988) | Dickin & Leung (1970) | Matsuo (1967) | Vesic (1971) | Oversen (1981) | Tucker  (1987) | Murray & Geddes (1987) | Clemeence and Vesseart (1977) | Kananyan (1966) |
| Expt. | Expt. | Expt. | Expt. | Expt. | Expt. | Expt. | Expt. | Expt. |
| i | 3 | 9.0 | 7.0 | 10.96 | 8.0 | 10.00 | 9.78 | 13.20 | 12.3 | 9.0 |
| ii | 4 | 13.5 | - | - | 11.0 | - | - | 18.50 | - | - |
| iii | 5 | 16.5 | - | - | 16.0 | - | - | 27.50 | - | - |

Table 9(a) Shape factor (non-dimensional) values of square anchor in both medium dense sand and dense sand

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment Ratio (H/B) | Authors | | Oversen &Stromann (1980) | Das & Seeley  (1975) | Hoshiya & Mandal (1984) | Dickin (1988) | Murray &  Geddes (1987) |
| Expt.  (φ = 43.5°) | Expt.  (φ = 46°) | Expt.  (φ = 36°) | Expt.  (φ = 30°) | Pred.  (φ = 36°) | Expt.  (φ = 38°) | Expt.  (φ = 44°) |
| i | 1 | - | - | - | - | - | 1.39 | 1.33 |
| ii | 2 | 1.86 | 2.60 | - | 1.79 | 2.06 | 2.28 | 1.83 |
| iii | 3 | 2.87 | 2.73 | - | 1.87 | 2.51 | 2.69 | 2.80 |
| iv | 4 | - | - | - | - | 2.45 | 2.90 | 3.10 |
| vi | 5 | 2.88 | 3.51 | - | - | 2.45 | 3.01 | 4.68 |
| vii | 6 | - | - | - | - | - | 3.23 | 4.52 |

Table 9(b) Shape factor(non-dimensional) values of Square anchor in the form (*B/L)* log (*H/B)*tan φ

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment ratio | Authors | | Das & Seeley  (1975)  Expt. (Φ=30°) | Hoshiya & Mandal  (1984)  Pred.(Φ=36°) | Dickin (1988)  Expt. (Φ=30°) | Murray & Geddes(1987)  Expt. (Φ=44°) |
| Expt.  (Φ=43.5°) | Expt.  (Φ=46°) |
| i | 2 | 0.2856 | 0.311 | 0.1738 | 0.218 | 0.235 | 0.29 |
| Ii | 3 | 0.452 | 0.494 | 0.235 | 0.3466 | 0.372 | 0.46 |
| iii | 4 | - | - | - | 0.437 | 0.47 | 0.58 |
| iv | 5 | 0.663 | 0.723 | - | 0.507 | 0.546 | 0.675 |

Table 10(a) Shape factor(non-dimensional ) values of Rectangular anchor in both medium dense sand and dense sand

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment Ratio (H/B) | Authors | | Baker & Kondner (1966) | Dickin (1988) | Dickin & Leung (1990) | Murray & Geddes (1987) | |
| Expt.  (φ=43.5°) | Expt.  (φ=46°) | Expt.  (φ = 39°) | Expt..  (φ = 38°) | Expt..  (φ = 32°) | Expt..  (φ= 36°) | Expt..  (φ = 44°) |
| i | 2 | 1.36 | 1.78 | - | - | - | - | - |
| ii | 3 | 2.0 | 1.90 | 2.80 | - | 1.89 | 1.98 | 2.62 |
| iii | 4 | - | - | - | - | - | - | 2.80 |
| iv | 5 | 2.03 | 2.38 | 2.80 | 2.75 | - | 2.05 | 2.80 |

Table 10 (b) Shape factor (non-dimensional) values of Rectangular anchor in the form *(B/L)* log (*H/B)*tan φ

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment ratio | Authors | | Dickin (1988)  Expt. (Φ=38°) | Murray & Geddes(1987)  Expt. (Φ=44°) |
| Expt.  (Φ=43.5°) | Expt.  (Φ=46°) |
| i | 2 | 0.191 | 0.207 | - | - |
| ii | 3 | 0.301 | 0.329 | 0.185 | 0.23 |
| iii | 4 | - | - | - | 0.29 |
| iv | 5 | 0.44 | 0.48 | - | 0.335 |

Table 11(a) Shape factor (non-dimensional) values of circular anchor in medium dense and dense sand

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment ratio | Authors | | Baker & Kondner (1966)  Expt. (Φ=39°) | Dickin (1988)  Expt. (Φ=38°) | Dickin & Leung(1990)  Expt.(Φ=32°) | Murray & Geddes(1987) | |
| Expt.  (Φ=43.5°) | Expt.  (Φ=46°) | Expt. (Φ=36°) | Expt. (Φ=44°) |
| i | 3 | 2.52 | 2.64 | 2.8 | - | 1.89 | 1.98 | 2.62 |
| ii | 4 | - | 2.85 | - | - | - | - | - |
| iii | 5 | 2.97 | 3.07 | 2.8 | 2.75 | - | 2.05 | 2.80 |

Table 11 (b) Shape factor (non-dimensional) values of circular anchor in the form (B/L) log (H/B)tan φ

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Sl.  No. | Embedment ratio | Authors | | Baker & Kondner (1966)  Expt. (Φ=39°) | Dickin (1988)  Expt.(Φ=38°) | Dickin & Leung(1990)  Expt.(Φ=32°) | Murray & Geddes(1987) | |
| Expt.  (Φ=43.5°) | Expt.  (Φ=46°) | Expt. (Φ=36°) | Expt.(Φ=44°) |
| i | 3 | 0.45 | 0.49 | 0.38 | - | 0.31 | 0.346 | 0.46 |
| ii | 4 | 0.57 | 0.62 | - | - | - | - | - |
| iii | 5 | 0.66 | 0.72 | 0.56 | 0.54 | - | 0.508 | 0.67 |







