PHICON Bearing Capacity Verification Report — MATCHED to v137

1. Inputs (from v137 defaults)

Parameter	Value
B (m)	2.000
L (m)	1.200
Df (m)	1.500
t_found (m)	0.600
γ_k (kN/m³)	19.000
γ_sat (editable) (kN/m³)	19.000
c′_k (kPa)	15.00
ϕ′_k (°)	32.00
c_u,k (kPa)	70.00
δ_k (°)	32.00
c_a,k (kPa)	0.00
z_wt (m)	2.00
V_k (kN)	800.00
H_B,k (kN)	120.00
M_L,k (kNm)	30.00

∆G (Derived permanent action) at characteristic level

Term	Working
A_plan = B·L	2.000×1.200 = 2.400 m²
G_self,k = 25·A_plan·t_found	25×2.400×0.600 = 36.00 kN
G_soil,k = γ_k·A_plan·t_found	19.00×2.400×0.600 = 27.36 kN
∆G_k = G_self,k – G_soil,k	36.00 – 27.36 = 8.64 kN
V_k,total = V_k + ∆G_k	800.00 + 8.64 = 808.64 kN

2. Combination Factors Summary (UK preset as in v137, editable in .html)

Factor	DA1■C1	DA1■C2
γ_G	1.35	1.00
γ_Q	1.50	1.00
γ_c	1.00	1.25
γ_ϕ	1.00	1.25

γ_γ	1.00	1.35
γ_cu	1.00	1.40
γ_Rv	1.00	1.00
γ_Rh	1.00	1.00

ULS Design Actions (from Combination Summary)

Case	V_d (kN)	H_B,d (kN)	M_L,d (kNm)
DA1■C1	1091.66	180.00	45.00
DA1■C2	808.64	120.00	30.00

3. SLS Bearing Capacity — Fully Worked (as per v137)

$e_B = M_{L,k} / V_{k,total} = 30.00 / 808.64 = 0.037$ m; $B' = B - 2e_B = 2.000 - 2\times0.037 = 1.926$ m; $A' = B'\cdot L = 1.926\times1.200 = 2.311$ m²
Bearing factors ($\phi'_k=32.00°$): $N_c=35.490$, $N_q=23.177$, $N_\gamma=30.215$
Shape factors (ratio=$B'/L=1.926/1.200$): $s_c=1.653$, $s_q=1.625$, $s_\gamma=0.600$
Inclination factors ($\alpha=H/V=120.00/808.64$): $i_q=0.725$, $i_\gamma=0.725$, $i_c=1.000$

Drained:

$q_d = c'\cdot N_c\cdot s_c\cdot i_c + \gamma\cdot D_f\cdot N_q\cdot s_q\cdot i_q + 0.5\cdot\gamma\cdot B'\cdot N_\gamma\cdot s_\gamma\cdot i_\gamma$
$= 15.00\times35.490\times1.653\times1.000 + 19.00\times1.500\times23.177\times1.625\times0.725 +$
$0.5\times19.00\times1.926\times30.215\times0.600\times0.725$
$= 880.01 + 778.38 + 240.53 =$ **1898.92 kPa**
$\eta = (q\cdot A')/V = (1898.92\times2.311)/800.00 =$ **5.49**

Undrained:

$q_d = c_u\cdot5.14 = 70.00\times5.14 =$ **359.80 kPa**
$\eta = (q\cdot A')/V = (359.80\times2.311)/800.00 =$ **1.04**

4.1 DA1■C1 — Drained

e_B = M_L,d / V_d = 45.00/1091.66 = 0.041 m; B′ = 2.000 − 2×0.041 = 1.918 m; A′ = 1.918×1.200 = 2.301 m²
ϕ′_d = arctan(tanϕ / γ_ϕ) = arctan(tan(32.00)/1.00) = 32.00°
c′_d = 15.00/γ_c = 15.00/1.00 = 15.00 kPa; γ_d = 19.00/γ_γ = 19.00/1.00 = 19.000 kN/m³
Bearing factors (ϕ′_d): N_c=35.490, N_q=23.177, N_γ=30.215
Shape factors: s_c=1.653, s_q=1.625, s_γ=0.600
Inclination (α=H/V=180.00/1091.66): i_q=0.697, i_γ=0.697, i_c=1.000
Overburden: q_overburden,k = z1·γ_k + z2·γ′_sub = 1.500×19.00 + 0.000×9.19 = 28.50 kPa; q_overburden,d = q_overburden,k/γ_γ = 28.50 kPa
Base window γ′_d = 11.748 kN/m³ (from water table ramp across B′)
q_d = c′_d·N_c·s_c·i_c + q_overburden,d·N_q·s_q·i_q + 0.5·γ′_d·B′·N_γ·s_γ·i_γ
= 15.00×35.490×1.653×1.000 + 28.50×23.177×1.625×0.697 + 0.5×11.748×1.918×30.215×0.600×0.697
= 880.01 + 748.53 + 142.41 = 1770.94 kPa
q_Rd = q_d/γ_Rv = 1770.94/1.00 = **1770.94 kPa**
η = (q_Rd·A′)/V_d = (1770.94×2.301)/1091.66 = **3.73**

4.2 DA1■C2 — Drained

e_B = M_L,d / V_d = 30.00/808.64 = 0.037 m; B′ = 2.000 − 2×0.037 = 1.926 m; A′ = 1.926×1.200 = 2.311 m²
ϕ′_d = arctan(tanϕ / γ_ϕ) = arctan(tan(32.00)/1.25) = 26.56°
c′_d = 15.00/γ_c = 15.00/1.25 = 12.00 kPa; γ_d = 19.00/γ_γ = 19.00/1.35 = 14.074 kN/m³
Bearing factors (ϕ′_d): N_c=23.180, N_q=12.588, N_γ=13.585
Shape factors: s_c=1.543, s_q=1.500, s_γ=0.600
Inclination (α=H/V=120.00/808.64): i_q=0.725, i_γ=0.725, i_c=1.000
Overburden: q_overburden,k = z1·γ_k + z2·γ′_sub = 1.500×19.00 + 0.000×9.19 = 28.50 kPa; q_overburden,d = q_overburden,k/γ_γ = 21.11 kPa
Base window γ′_d = 8.694 kN/m³ (from water table ramp across B′)
q_d = c′_d·N_c·s_c·i_c + q_overburden,d·N_q·s_q·i_q + 0.5·γ′_d·B′·N_γ·s_γ·i_γ
= 12.00×23.180×1.543×1.000 + 21.11×12.588×1.500×0.725 + 0.5×8.694×1.926×13.585×0.600×0.725
= 429.21 + 289.06 + 49.49 = 767.75 kPa
q_Rd = q_d/γ_Rv = 767.75/1.00 = **767.75 kPa**
η = (q_Rd·A′)/V_d = (767.75×2.311)/808.64 = **2.19**

4.3 DA1■C1 — Undrained

q_d = (c_u/γ_cu)·5.14 = (70.00/1.00)×5.14 = 359.80 kPa
q_Rd = 359.80/1.00 = **359.80 kPa**
η = (q_Rd·A′)/V_d = (359.80×2.301)/1091.66 = **0.76**

4.4 DA1■C2 — Undrained

q_d = (c_u/γ_cu)·5.14 = (70.00/1.40)×5.14 = 257.00 kPa
q_Rd = 257.00/1.00 = **257.00 kPa**
η = (q_Rd·A′)/V_d = (257.00×2.311)/808.64 = **0.73**

5. Stability Checks — Fully Worked

5.1 Sliding — DA1■C1

$\delta_d = \arctan(\tan(\delta_k) / \gamma_\phi) = \arctan(\tan(32.00°)/1.00) = 32.00°$
$R_{h,Ed} = V_d \cdot \tan\delta_d + c_{a,d} \cdot A'/1000 = 1091.66 \times \tan(32.00°) + (0.00 \times 2.301)/1000 = 682.15$ kN
$R_{h,Rd} = R_{h,Ed}/\gamma_{Rh} = 682.15/1.00 =$ **682.15 kN**
$\eta = R_{h,Rd} / H_{Ed} = 682.15/180.00 =$ **3.79**

5.2 Sliding — DA1■C2

$\delta_d = \arctan(\tan(\delta_k) / \gamma_\phi) = \arctan(\tan(32.00°)/1.25) = 26.56°$
$R_{h,Ed} = V_d \cdot \tan\delta_d + c_{a,d} \cdot A'/1000 = 808.64 \times \tan(26.56°) + (0.00 \times 2.311)/1000 = 404.24$ kN
$R_{h,Rd} = R_{h,Ed}/\gamma_{Rh} = 404.24/1.00 =$ **404.24 kN**
$\eta = R_{h,Rd} / H_{Ed} = 404.24/120.00 =$ **3.37**

5.3 Overturning about B

C1: $e_B = M_{L,d}/V_d = 45.00/1091.66 = 0.041$ m; limit B/6 = 0.333 m $\rightarrow \eta = 0.333/0.041 =$ **8.09**
C2: $e_B = M_{L,d}/V_d = 30.00/808.64 = 0.037$ m; limit B/6 = 0.333 m $\rightarrow \eta = 0.333/0.037 =$ **8.98**

6. Summary of Overdesign Factors ($\eta \geq 1 \Rightarrow$ OK)

Check	Case	η	Status
Bearing (SLS, drained)	—	5.49	OK
Bearing (SLS, undrained)	—	1.04	OK
Bearing (ULS, drained)	DA1■C1	3.73	OK
Bearing (ULS, undrained)	DA1■C1	0.76	Not OK
Bearing (ULS, drained)	DA1■C2	2.19	OK
Bearing (ULS, undrained)	DA1■C2	0.73	Not OK
Sliding	DA1■C1	3.79	OK
Sliding	DA1■C2	3.37	OK
Overturning (B)	DA1■C1	8.09	OK
Overturning (B)	DA1■C2	8.98	OK