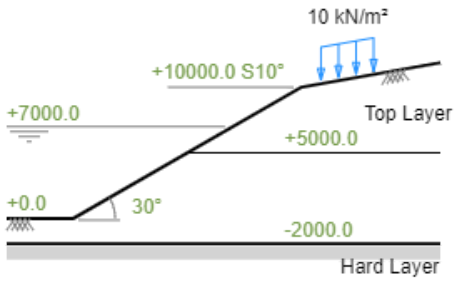
1.0 INPUT

1.1 Design Options

Unit		=	**SI Unit**

1.2 Slope Construction

Slope Height	H	=	**10000** mm
Slope Angle	β	=	**30** deg
Top Surface Slope	β'	=	**10** deg
Depth of Upper Soil Layer	H_A	=	**5000** mm



Slope Construction

1.3 Surcharge Loads

Surcharge Loads			**Finite**
Distributed Load	Odl	=	**10** kN/m²
Start Length	Sl	=	**1500** mm
Load Width	Lw	=	**4000** mm

1.4 Slip Circle Analysis

Analysis Method		=	**Program Defined**

1.5 Soil Properties

Number of Layers of Soil Fill		=	**2**
Unit Weight of Upper Soil	γ_A	=	**18** kN/m³
Unit Weight of Lower Soil	γ_B	=	**20** kN/m³
Cohesion of Upper Soil	C'_A	=	**10** kN/m²
Cohesion of Lower Soil	C'_B	=	**15** kN/m²
Angle of Internal Friction of Upper Soil	Φ_A	=	**25** deg
Angle of Internal Friction of Lower soil	Φ_B	=	**30** deg
Pore Pressure Ratio	R_u	=	**0**

1.6 Hard Surface and Water Levels

Water Level	W	=	**7000** mm
Depth of Hard Layer	H_L	=	**2000** mm

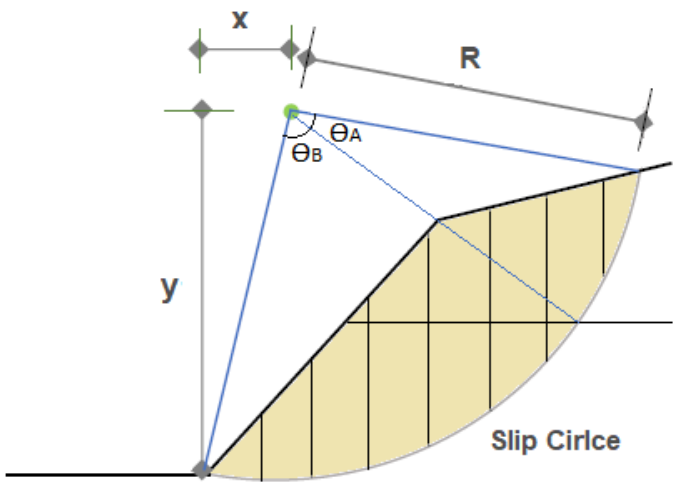
1.7 Factor of Safety

Required Factor of Safety		=	**1.5**

2.0 OUTPUT

Horizontal Length of Slope	L = H / tan β	**17320.5** mm

2.1 Fellenius Method of Slip Circle Analysis



A - Area of Corresponding Slice (m^2)

W_L - Surcharge Load of Corresponding Slice

W_A - Weight of Corresponding Slice of Upper Layer (kN/m) = A * γ'_A

W_B - Weight of Corresponding Slice of Lower Layer (kN/m) = A * γ'_B

γ' - Unit Weight of Soil = γ or γ - γ_w (Unit weight of Water for Submerged Layers)

W - Weight of Combined Slices (kN/m) = $W_A + W_B + W_L$

x_i - Centroid Horizontal Distance of Corresponding Slice from Center of Circle (mm)

α - Angle of Corresponding Slice (deg) = $\sin^{-1}(x_i/R_a)$

N'A - Effective Normal Reaction Force at the Base of Slice of Upper Soil (kN/m)

= (W_A - W_L) * (cos α - R_u * sec α) (>= 0) + W_L * cos α

N'B - Effective Normal Reaction Force at the Base of Slice of Lower Soil (kN/m)

= (W_B - W_L) * (cos α - R_u * sec α) (>= 0) + W_L * cos α

T - Shearing Force Induced along Base (kN/m)

= W * sin α

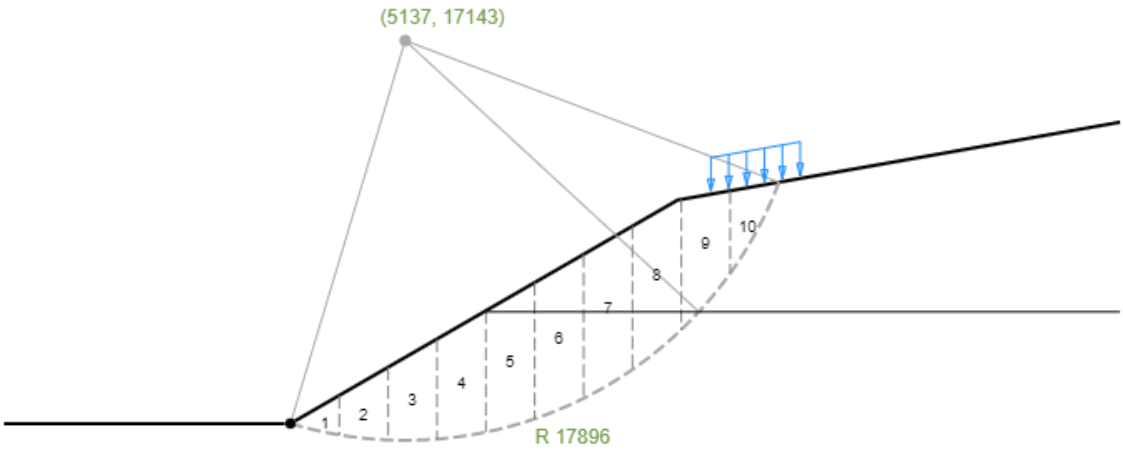
2.2 Auto Analysis Trials

Trial No	Circle Center x (mm)	Circle Center y (mm)	Circle Radius R (mm)	FOS
1	10274.0	14934.0	18126.0	2.269
2	9247.0	15376.0	17942.0	2.166
3	8219.0	15817.0	17824.0	2.057
4	7192.0	16259.0	17778.0	1.969
5	6165.0	16701.0	17802.0	1.905
6	5137.0	17143.0	17896.0	1.901
7	4110.0	17585.0	18058.0	1.919
8	3082.0	18027.0	18288.0	1.997
9	2055.0	18469.0	18582.0	2.119
10	1027.0	18910.0	18937.0	2.298

11	0.0	19352.0	19000.0	2.861
12	-1027.0	19794.0	19000.0	4.272
13	-2055.0	20236.0	19000.0	10.799

2.3 Critical Slip Circle Parameters

Number of Slices	N	=	**10**
Horizontal Offset of Origin	x	=	**5137.0** mm
Vertical Offset of Origin	y	=	**17143.0** mm
Radius	R_a	=	**17896.0** mm
Total Horizontal Length of Slices	L'	=	**21545.5** mm
Width of Each Slices	D_i	= L' / N	**2154.6** mm



Slice No.	Area m^2	W (W_L) kN/m	x_i mm	α deg	N'A kN/m	N'B kN/m	T kN/m
1	1.9	19.2 (0.0)	-3700.5	-11.93	0.0	18.8	-4.0
2	5.4	54.5 (0.0)	-1798.4	-5.77	0.0	54.3	-5.5
3	8.2	84.1 (0.0)	306.4	0.98	0.0	84.0	1.4
4	10.6	107.8 (0.0)	2438.9	7.83	0.0	106.8	14.7
5	12.3	123.1 (0.0)	4572.3	14.80	0.0	119.1	31.5
6	13.5	130.0 (0.0)	6722.5	22.06	0.0	120.4	48.8
7	13.9	149.6 (0.0)	8889.6	29.78	0.0	129.8	74.3
8	13.4	167.0 (0.0)	11036.4	38.08	0.0	131.4	103.0
9	10.7	159.4 (5.7)	13166.9	47.37	49.9	57.8	117.3
10	4.4	98.4 (21.5)	15060.2	57.30	53.1	0.0	82.8

Upper Layer Sector Angle	$\Theta_A =$	**19.2** deg
Lower Layer Sector Angle	$\Theta_B =$	**64.0** deg
Total Sector Angle	$\Theta = \Theta_A + \Theta_B$	**83.2** deg
Total Effective Normal Reaction Forces	$\Sigma N'A =$	**103.1** kN/m
Total Effective Normal Reaction Forces	$\Sigma N'B =$	**822.5** kN/m
Total Shearing Forces Included along Base	$\Sigma T =$	**464.3** kN/m

Factor of Safety $F = \frac{R_a * (C'_A * \Theta_A + C'_B * \Theta_B) + Tan\Phi_A * \Sigma N'A + Tan\Phi_B * \Sigma N'B}{\Sigma T}$

= **1.901**

3.0 SUMMARY

Description	Required	Actual	Status
Factor of Safety	≥ 1.5	1.901	PASS