Cantilever Sheet Pile Embedment and Maximum Moment

Embedment depth, point of zero shear and maximum bending moment of a cantilever sheet pile wall in uniform cohesionless soil by a simplified Rankine method.

Method: Simplified cantilever sheet pile analysis (Rankine pressures)

Input parameters

Unit system: SI

Parameter	Value	Unit
Retained height	4.0000	m
Soil unit weight	18.000	kN/m³
Friction angle	30.000	°
Factor on passive resistance	1.5000	
Embedment increase factor	1.2000	
Allowable bending stress of the pile	180.00	MPa

Calculated results

Parameter	Value	Unit
Active coefficient	0.33333	
Passive coefficient	3.0000	
Embedment for moment balance	4.8952	m
Design embedment	5.8743	m
Depth of zero shear below dredge level	2.7596	m
Maximum moment per metre run (kN·m/m)	182.77	kN
Section modulus per metre (cm³/m)	1,015.4	cm³

Notes for this case

• Simplified (Blum) method: moments about the toe of active pressure on H + D and factored passive pressure on D balance; the toe reaction is allowed for by increasing D by about 20 %. Dry, cohesionless soil without surcharge or water; use a full analysis with water levels for real walls.

Formula and method

$$\frac{K_p}{F_p}D^3 = K_a(H+D)^3, \quad z_0 = \frac{H}{\sqrt{K_p/(F_pK_a)}-1}, \quad M_{max} = \frac{\gamma}{6}\left[K_a(H+z_0)^3 - \frac{K_p}{F_p}z_0^3\right]$$

Variables

H	Retained height	m
γ	Soil unit weight	N/m³
\phi'	Friction angle	rad
F_p	Factor on passive resistance	-
k_D	Embedment increase factor	-
σ_{all}	Allowable bending stress of the pile	Pa
K_a	Active coefficient	-
K_p	Passive coefficient	-
D_0	Embedment for moment balance	m
D	Design embedment	m

z_0	Depth of zero shear below dredge level	m
M_{max}	Maximum moment per metre run (kN·m/m)	N
Z_{req}	Section modulus per metre (cm³/m)	m³

Method and standards

Cantilever sheet pile.

Assumptions and limits

- Uniform dry cohesionless soil; no surcharge.

References

Simplified cantilever sheet pile analysis (Rankine pressures)

Report details

Report reference	FCC-GRAD-JD7K (the same inputs always give the same reference)
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Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/civil/foundations/sheet-pile-cantilever-embedment

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Reopens the calculator with the inputs of this report.