

Prefab wall analysis

Input data (Stage of construction 1)

Project : 1386 & 1394 Greely Lane, Ottawa, ON
 Customer : Permacon
 Date : 6/18/2025
 Project number : PG7563

Settings

CHBDC

Materials and standards

Concrete structures : CSA A23.3-14

Wall analysis

Verification methodology : according to LRFD
 Active earth pressure calculation : Coulomb
 Passive earth pressure calculation : Mazindrani (Rankine)
 Earthquake analysis : Mononobe-Okabe
 Shape of earth wedge : Calculate as skew
 Allowable eccentricity : 0.333

Load factors			
Design situation - Strength I			
		Minimum	Maximum
Dead load of structural components :	DC =	0.95 [-]	1.10 [-]
Dead load of wearing surfaces :	DW =	0.65 [-]	1.50 [-]
Earth pressure - active :	EH_A =	0.80 [-]	1.25 [-]
Earth pressure - at rest :	EH_R =	0.80 [-]	1.25 [-]
Earth surcharge load (permanent) :	ES =	0.80 [-]	1.25 [-]
Vertical pressure of earth fill :	EV =	1.00 [-]	1.35 [-]
Live load surcharge :	LL =	1.70 [-]	1.70 [-]
Water load :	WA =	0.90 [-]	1.10 [-]

Resistance factors			
Design situation - Strength I			
Resistance factor on overturning :	ϕ_o =	0.55 [-]	
Resistance factor on sliding :	ϕ_t =	0.90 [-]	
Resistance factor on bearing capacity :	ϕ_b =	1.00 [-]	
Resistance factor on passive pressure :	ϕ_{VE} =	0.50 [-]	

Load factors			
Design situation - Service I			
		Minimum	Maximum
Dead load of structural components :	DC =	1.00 [-]	1.00 [-]
Dead load of wearing surfaces :	DW =	1.00 [-]	1.00 [-]
Earth pressure - active :	EH_A =	1.00 [-]	1.00 [-]
Earth pressure - at rest :	EH_R =	1.00 [-]	1.00 [-]
Earth surcharge load (permanent) :	ES =	1.00 [-]	1.00 [-]

Load factors

Design situation - Service I

Vertical pressure of earth fill :	EV =	1.00	[-]	1.00	[-]
Live load surcharge :	LL =	0.90	[-]	0.90	[-]
Water load :	WA =	1.00	[-]	1.00	[-]

Resistance factors

Design situation - Service I

Resistance factor on overturning :	$\varphi_o =$	1.00	[-]
Resistance factor on sliding :	$\varphi_t =$	1.00	[-]
Resistance factor on bearing capacity :	$\varphi_b =$	1.00	[-]
Resistance factor on passive pressure :	$\varphi_{VE} =$	1.00	[-]

Load factors

Design situation - Extreme I

		Minimum	Maximum
Dead load of structural components :	DC =	0.80 [-]	1.25 [-]
Dead load of wearing surfaces :	DW =	0.80 [-]	1.25 [-]
Earth pressure - active :	$EH_A =$	0.90 [-]	1.50 [-]
Earth pressure - at rest :	$EH_R =$	0.90 [-]	1.35 [-]
Earth surcharge load (permanent) :	ES =	0.80 [-]	1.25 [-]
Vertical pressure of earth fill :	EV =	1.00 [-]	1.35 [-]
Live load surcharge :	LL =	0.00 [-]	0.00 [-]
Water load :	WA =	1.00 [-]	1.00 [-]

Resistance factors

Design situation - Extreme I

Resistance factor on overturning :	$\varphi_o =$	1.00	[-]
Resistance factor on sliding :	$\varphi_t =$	1.00	[-]
Resistance factor on bearing capacity :	$\varphi_b =$	1.00	[-]
Resistance factor on passive pressure :	$\varphi_{VE} =$	1.00	[-]

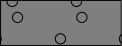
Geometry of structure

Slope of wall = 0.00 °

No.	Block width w [m]	Block height h [m]	Offset k [m]	Offs.(L) o ₁ [m]	Offs.(R) o ₂ [m]	Merge	Unit weight [kN/m ³]	Block friction [-]	Cohesion [kPa]	Shear bear.cap. [kN/m]	
										F _{min}	F _{max}
9	0.44	0.20	-0.050	0.000	0.000	No	22.00	0.533	0.00	0.00	-
8	0.38	0.20	0.000	0.000	0.000	No	22.00	0.533	0.00	0.00	-
7	0.75	0.20	0.063	0.000	0.000	No	22.00	0.533	0.00	0.00	-
6	0.38	0.20	0.000	0.000	0.000	No	22.00	0.533	0.00	0.00	-
5	0.38	0.20	0.063	0.000	0.000	No	22.00	0.533	0.00	0.00	-
4	0.38	0.20	0.000	0.000	0.000	No	22.00	0.533	0.00	0.00	-
3	0.75	0.20	0.063	0.000	0.000	No	22.00	0.533	0.00	0.00	-
2	0.75	0.20	0.000	0.000	0.000	No	22.00	0.533	0.00	0.00	-
1	0.75	0.20	-	0.000	0.000	-	22.00	-	-	-	-

Note: Blocks are ordered from bottom to the top

Basic soil parameters

No.	Name	Pattern	ϕ_{ef} [°]	c_{ef} [kPa]	γ [kN/m³]	γ_{su} [kN/m³]	δ [°]
1	Granular B		38.00	0.00	22.00	12.00	26.00
2	Engineered Fill		38.00	0.00	22.00	12.00	26.00
3	native soil		30.00	0.00	19.00	9.00	20.00

All soils are considered as cohesionless for at rest pressure analysis.

Soil parameters

Granular B

Unit weight : $\gamma = 22.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 38.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 26.00^\circ$
 Soil : cohesionless
 Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

Engineered Fill

Unit weight : $\gamma = 22.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 38.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 26.00^\circ$
 Soil : cohesionless
 Saturated unit weight : $\gamma_{sat} = 22.00 \text{ kN/m}^3$

native soil

Unit weight : $\gamma = 19.00 \text{ kN/m}^3$
 Stress-state : effective
 Angle of internal friction : $\phi_{ef} = 30.00^\circ$
 Cohesion of soil : $c_{ef} = 0.00 \text{ kPa}$
 Angle of friction struc.-soil : $\delta = 20.00^\circ$
 Soil : cohesionless
 Saturated unit weight : $\gamma_{sat} = 19.00 \text{ kN/m}^3$

Backfill

Assigned soil : Granular B

Slope = 45.00°

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	1.00	0.00 .. 1.00	Engineered Fill	
2	-	1.00 .. ∞	native soil	

Foundation

Type of foundation : strip foundation
Soil of foundation - Granular B

Geometry

Foundation thickness $h = 0.20 \text{ m}$
Offset left $b_l = 0.20 \text{ m}$
Offset right $b_p = 0.20 \text{ m}$

Terrain profile

Terrain behind the structure is flat.

Water influence

Ground water table is located below the structure.

Input surface surcharges

No.	Surcharge		Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	Yes		variable	12.00		0.50	10.00	on terrain

No.	Name
1	Live Load

Resistance on front face of the structure

Resistance on front face of the structure: at rest
Soil on front face of the structure - Engineered Fill
Soil thickness in front of structure $h = 0.25 \text{ m}$
Terrain in front of structure is flat.

Earthquake

Factor of horizontal acceleration $K_h = 0.2015$
Factor of vertical acceleration $K_v = 0.0000$

Water below the GWT is restricted.

Global settings

Settings of the stage of construction

Design situation : Extreme I
The wall is free to move. Active earth pressure is therefore assumed.
Reduction of soil/soil friction angle : do not reduce

Verification No. 1 (Stage of construction 1)

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-0.81	21.78	0.39	0.800	0.800	1.250
Earthq.- constr.	4.39	-0.81	0.00	0.39	1.000	1.000	1.000
FF resistance	-0.26	-0.08	0.00	0.00	0.900	0.900	1.350
Weight - earth wedge	0.00	-0.80	2.44	0.59	1.000	1.000	1.350
Earthquake - soil wedge	0.49	-0.80	0.00	0.59	1.000	1.000	1.000
Weight - earth wedge	0.00	-1.57	2.35	0.71	1.000	1.000	1.350
Earthquake - soil wedge	0.47	-1.57	0.00	0.71	1.000	1.000	1.000
Active pressure	7.54	-0.63	8.74	1.09	0.900	1.500	1.500
Earthq.- act.pressure	5.00	-1.21	8.44	0.95	1.000	1.000	1.000
Live Load	2.75	-0.69	2.68	1.08	0.000	0.000	0.000

Verification of complete wall**Check for overturning stability**Resisting moment $M_{res} = 26.61 \text{ kNm/m}$ Overturning moment $M_{ovr} = 14.98 \text{ kNm/m}$

Capacity demand ratio CDR = 1.78

Wall for overturning is SATISFACTORY**Check for slip**Resisting horizontal force $H_{res} = 34.20 \text{ kN/m}$ Active horizontal force $H_{act} = 21.43 \text{ kN/m}$

Capacity demand ratio CDR = 1.60

Wall for slip is SATISFACTORY**Overall check - WALL is SATISFACTORY**

Maximum stress in footing bottom : 78.33 kPa

Bearing capacity of foundation soil (Stage of construction 1)**Design load acting at the center of footing bottom**

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
1	1.23	55.26	21.31	0.030	78.33
2	2.82	38.53	21.43	0.098	63.84

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	2.60	46.44	20.38

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verificationMax. eccentricity of normal force $e = 0.098$ Maximum allowable eccentricity $e_{alw} = 0.333$ **Eccentricity of the normal force is SATISFACTORY****Verification of bearing capacity**Max. stress at footing bottom $\sigma = 78.33 \text{ kPa}$ Allowable bearing capacity of foundation soil $R_d = 150.00 \text{ kPa}$

Capacity demand ratio CDR = 1.91

Bearing capacity of foundation soil is SATISFACTORY**Overall verification - bearing capacity of found. soil is SATISFACTORY****Dimensioning No. 1 (Stage of construction 1)****Forces acting on construction**

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overturn.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-0.10	1.94	0.17	0.800	0.800	1.250
Earthq.- constr.	0.39	-0.10	0.00	0.17	1.000	1.000	1.000

Name	F _{hor} [kN/m]	App.Pt. z [m]	F _{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Active pressure	0.09	-0.07	0.04	0.39	0.900	1.500	1.500
Earthq.- act.pressure	0.05	-0.13	0.03	0.39	1.000	1.000	1.000
Live Load	0.00	-0.20	0.00	0.39	0.000	0.000	0.000

Verification of construction joint above the block No.: 8

Check for overturning stability

Resisting moment $M_{res} = 0.29 \text{ kNm/m}$

Overturning moment $M_{ovr} = 0.05 \text{ kNm/m}$

Capacity demand ratio CDR = 5.63

Joint for overturning stability is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 0.87 \text{ kN/m}$

Active horizontal force $H_{act} = 0.57 \text{ kN/m}$

Capacity demand ratio CDR = 1.53

Joint for slip is SATISFACTORY

Input data (Stage of construction 2)

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	1.00	0.00 .. 1.00	Engineered Fill	
2	-	1.00 .. ∞	native soil	

Foundation

Type of foundation : strip foundation

Soil of foundation - Granular B

Geometry

Foundation thickness $h = 0.20 \text{ m}$

Offset left $b_l = 0.20 \text{ m}$

Offset right $b_p = 0.20 \text{ m}$

Terrain profile

Terrain behind the structure is flat.

Water influence

Ground water table is located below the structure.

Input surface surcharges

No.	Surcharge		Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	No	No	variable	12.00		0.50	10.00	on terrain

No.	Name
1	Live Load

Resistance on front face of the structure

Resistance on front face of the structure: at rest

Soil on front face of the structure - Engineered Fill

Soil thickness in front of structure $h = 0.25 \text{ m}$

Terrain in front of structure is flat.

Earthquake

Factor of horizontal acceleration $K_h = 0.0000$

Factor of vertical acceleration $K_v = 0.0000$

Water below the GWT is restricted.

Settings of the stage of construction

Design situation : Strength I

The wall is free to move. Active earth pressure is therefore assumed.

Reduction of soil/soil friction angle : do not reduce

Verification No. 1 (Stage of construction 2)

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-0.81	21.78	0.39	0.950	0.950	1.100
Earthq.- constr.	0.00	-0.81	0.00	0.39	1.000	1.000	1.000
FF resistance	-0.26	-0.08	0.00	0.00	0.800	0.800	1.250
Weight - earth wedge	0.00	-0.80	2.44	0.59	1.000	1.000	1.350
Earthquake - soil wedge	0.00	-0.80	0.00	0.59	1.000	1.000	1.000
Weight - earth wedge	0.00	-1.57	2.35	0.71	1.000	1.000	1.350
Earthquake - soil wedge	0.00	-1.57	0.00	0.71	1.000	1.000	1.000
Active pressure	7.54	-0.63	8.74	1.09	0.800	1.250	1.250
Earthq.- act.pressure	0.00	-1.80	0.00	0.74	1.000	1.000	1.000
Live Load	2.75	-0.69	2.68	1.08	1.700	1.700	1.700

Verification of complete wall

Check for overturning stability

Resisting moment $M_{res} = 13.10 \text{ kNm/m}$

Overturning moment $M_{ovr} = 7.00 \text{ kNm/m}$

Capacity demand ratio CDR = 1.87

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 28.81 \text{ kN/m}$

Active horizontal force $H_{act} = 13.88 \text{ kN/m}$

Capacity demand ratio CDR = 2.08

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 61.22 kPa

Bearing capacity of foundation soil (Stage of construction 2)

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
1	-4.17	45.91	13.76	0.000	61.22

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
2	-2.93	37.03	13.88	0.000	49.38

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	-3.29	38.00	10.02

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verification

Max. eccentricity of normal force $e = 0.000$

Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Max. stress at footing bottom $\sigma = 61.22$ kPa

Allowable bearing capacity of foundation soil $R_d = 150.00$ kPa

Capacity demand ratio $CDR = 2.45$

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Dimensioning No. 1 (Stage of construction 2)**Forces acting on construction**

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-0.10	1.94	0.17	0.950	0.950	1.100
Earthq.- constr.	0.00	-0.10	0.00	0.17	1.000	1.000	1.000
Active pressure	0.09	-0.07	0.04	0.39	0.800	1.250	1.250
Earthq.- act.pressure	0.00	-0.20	0.00	0.39	1.000	1.000	1.000
Live Load	0.00	-0.20	0.00	0.39	1.700	1.700	1.700

Verification of construction joint above the block No.: 8**Check for overturning stability**

Resisting moment $M_{res} = 0.18$ kNm/m

Overturning moment $M_{ovr} = 0.00$ kNm/m

Capacity demand ratio $CDR = 39.16$

Joint for overturning stability is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 0.91$ kN/m

Active horizontal force $H_{act} = 0.11$ kN/m

Capacity demand ratio $CDR = 8.46$

Joint for slip is SATISFACTORY

Input data (Stage of construction 3)

Geological profile and assigned soils

No.	Thickness of layer t [m]	Depth z [m]	Assigned soil	Pattern
1	1.00	0.00 .. 1.00	Engineered Fill	
2	-	1.00 .. ∞	native soil	

Foundation

Type of foundation : strip foundation

Soil of foundation - Granular B

Geometry

Foundation thickness $h = 0.20$ m

Offset left $b_l = 0.20$ m

Offset right $b_p = 0.20$ m

Terrain profile

Terrain behind the structure is flat.

Water influence

Ground water table is located below the structure.

Input surface surcharges

No.	Surcharge		Action	Mag.1 [kN/m ²]	Mag.2 [kN/m ²]	Ord.x x [m]	Length l [m]	Depth z [m]
	new	change						
1	No	No	variable	12.00		0.50	10.00	on terrain

No.	Name
1	Live Load

Resistance on front face of the structure

Resistance on front face of the structure: at rest

Soil on front face of the structure - Engineered Fill

Soil thickness in front of structure $h = 0.25$ m

Terrain in front of structure is flat.

Earthquake

Factor of horizontal acceleration $K_h = 0.0000$

Factor of vertical acceleration $K_v = 0.0000$

Water below the GWT is restricted.

Settings of the stage of construction

Design situation : Service I

The wall is free to move. Active earth pressure is therefore assumed.

Reduction of soil/soil friction angle : do not reduce

Verification No. 1 (Stage of construction 3)

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-0.81	21.78	0.39	1.000	1.000	1.000
Earthq.- constr.	0.00	-0.81	0.00	0.39	1.000	1.000	1.000

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
FF resistance	-0.26	-0.08	0.00	0.00	1.000	1.000	1.000
Weight - earth wedge	0.00	-0.80	2.44	0.59	1.000	1.000	1.000
Earthquake - soil wedge	0.00	-0.80	0.00	0.59	1.000	1.000	1.000
Weight - earth wedge	0.00	-1.57	2.35	0.71	1.000	1.000	1.000
Earthquake - soil wedge	0.00	-1.57	0.00	0.71	1.000	1.000	1.000
Active pressure	7.54	-0.63	8.74	1.09	1.000	1.000	1.000
Earthq.- act.pressure	0.00	-1.80	0.00	0.74	1.000	1.000	1.000
Live Load	2.75	-0.69	2.68	1.08	0.900	0.900	0.900

Verification of complete wall

Check for overturning stability

Resisting moment $M_{res} = 23.85 \text{ kNm/m}$

Overturning moment $M_{ovr} = 6.42 \text{ kNm/m}$

Capacity demand ratio CDR = 3.72

Wall for overturning is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 29.48 \text{ kN/m}$

Active horizontal force $H_{act} = 9.75 \text{ kN/m}$

Capacity demand ratio CDR = 3.02

Wall for slip is SATISFACTORY

Overall check - WALL is SATISFACTORY

Maximum stress in footing bottom : 50.31 kPa

Bearing capacity of foundation soil (Stage of construction 3)

Design load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]	Eccentricity [-]	Stress [kPa]
1	-3.29	37.73	9.75	0.000	50.31

Service load acting at the center of footing bottom

No.	Moment [kNm/m]	Norm. force [kN/m]	Shear Force [kN/m]
1	-3.29	38.00	10.02

Verification of foundation soil

Stress in the footing bottom : rectangle

Eccentricity verification

Max. eccentricity of normal force $e = 0.000$

Maximum allowable eccentricity $e_{alw} = 0.333$

Eccentricity of the normal force is SATISFACTORY

Verification of bearing capacity

Max. stress at footing bottom $\sigma = 50.31 \text{ kPa}$

Allowable bearing capacity of foundation soil $R_d = 150.00 \text{ kPa}$

Capacity demand ratio $CDR = 2.98$

Bearing capacity of foundation soil is SATISFACTORY

Overall verification - bearing capacity of found. soil is SATISFACTORY

Dimensioning No. 1 (Stage of construction 3)

Forces acting on construction

Name	F_{hor} [kN/m]	App.Pt. z [m]	F_{vert} [kN/m]	App.Pt. x [m]	Coeff. overtur.	Coeff. sliding	Coeff. stress
Weight - wall	0.00	-0.63	11.88	0.33	1.000	1.000	1.000
Earthq.- constr.	0.00	-0.63	0.00	0.33	1.000	1.000	1.000
Weight - earth wedge	0.00	-0.97	2.35	0.65	1.000	1.000	1.000
Earthquake - soil wedge	0.00	-0.97	0.00	0.65	1.000	1.000	1.000
Active pressure	3.16	-0.41	2.20	0.61	1.000	1.000	1.000
Earthq.- act.pressure	0.00	-1.20	0.00	0.68	1.000	1.000	1.000
Live Load	2.05	-0.44	1.25	0.61	0.900	0.900	0.900

Verification of construction joint above the block No.: 3

Check for overturning stability

Resisting moment $M_{res} = 7.47 \text{ kNm/m}$

Overturning moment $M_{ovr} = 2.11 \text{ kNm/m}$

Capacity demand ratio $CDR = 3.54$

Joint for overturning stability is SATISFACTORY

Check for slip

Resisting horizontal force $H_{res} = 9.36 \text{ kN/m}$

Active horizontal force $H_{act} = 5.01 \text{ kN/m}$

Capacity demand ratio $CDR = 1.87$

Joint for slip is SATISFACTORY