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1. CODE AND MATERIALS

Code: ACI 318M-11 (USA)
Concrete: f'c=280
Steel Grade: Grade 60
Cover in the wall's infill face: 7.5 cm
Cover in the wall's backfill face: 7.5 cm
Foundation top cover: 7.0 cm
Foundation bottom cover: 7.5 cm
Foundation lateral cover: 7.5 cm
Maximum size of aggregate: 30 mm

2. LOADS

Seismic acceleration. Design acceleration: 0.15 Surcharge percentage: 0 %
Infill lateral pressure: No pressures
Backfill lateral pressure: Active

3. GENERAL DATA

Ground level elevation: 0.00 m
Height of the wall above ground level: 0.00 m
Alignment: Without level
Wall length on plan: 5.00 m
Joint spacing: 5.00 m
Type of foundation: Strip footing

4. SOIL DESCRIPTION

Percentage of the internal friction between the soil and wall infill face: 0 %
Percentage of the internal friction between the soil and wall backfill face: 66 %
Drainage loss: 100 %
Allowable bearing pressure: 0.600 MPa
Soil-foundation friction coefficient: 0.90

LAYERS

References	Top elevation	Description	Earth pressure coefficients
1 - backfill	0.00 m	Apparent unit weight: 20.00 kN/m³ Submerged unit weight: 11.00 kN/m³ Internal friction angle: 30.00 degrees Cohesion: 0.00 kN/m²	Active backfill: 0.28
2	-3.50 m	Apparent unit weight: 18.00 kN/m³ Submerged unit weight: 11.00 kN/m³ Internal friction angle: 40.00 degrees Cohesion: 1.00 kN/m²	Active backfill: 0.18

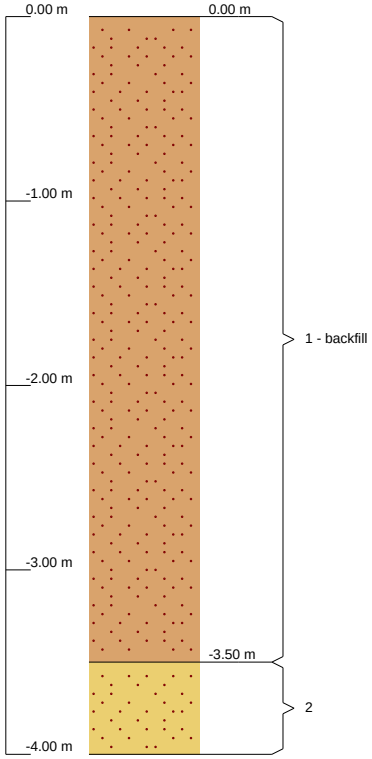
INFILL SOIL

References	Description	Earth pressure coefficients
Fill	Apparent unit weight: 20.00 kN/m³ Submerged unit weight: 11.00 kN/m³ Internal friction angle: 33.00 degrees Cohesion: 0.00 kN/m²	Active backfill: 0.25

BACKFILL SOIL

References	Description	Earth pressure coefficients
Fill	Apparent unit weight: 20.00 kN/m³ Submerged unit weight: 11.00 kN/m³ Internal friction angle: 33.00 degrees Cohesion: 0.00 kN/m²	Active backfill: 0.25

5. SOIL PROFILE



6. GEOMETRY

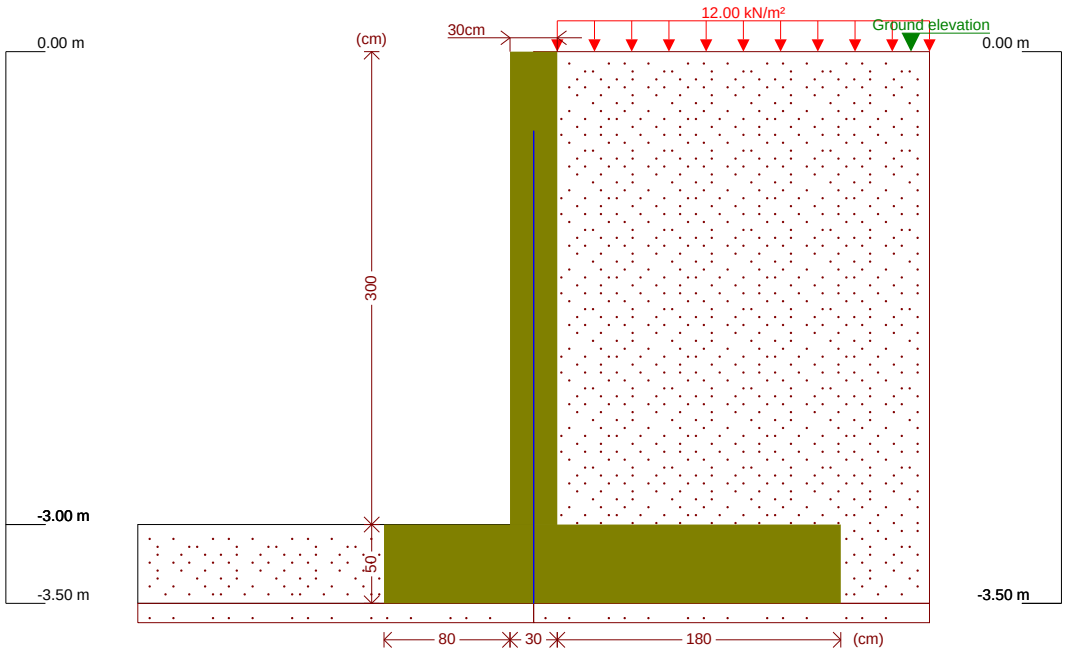
WALL

Height: 3.00 m
Top thickness: Infill: 15.0 cm / Backfill: 15.0 cm
Bottom thickness: Infill: 15.0 cm / Backfill: 15.0 cm

STRIP FOOTING

With toe and heel
Depth: 50 cm
Overhangs infill / backfill: 80.0 / 180.0 cm
Mud slab: 10 cm

7. PHASE DIAGRAMS



Phase 1: Phase

8. LOADS

LOADS ON BACKFILL

Type	Elevation	Data	Initial phase	Final phase
Uniform	On the surface	Value: 12 kN/m²	Phase	Phase

9. PHASE RESULTS

Unfactored loads.

PHASE 1: PHASE

SELF WEIGHT AND SOIL PRESSURES WITH SURCHARGE

Elevation (m)	Axial (kN/m)	Shear (kN/m)	Bending moment (kN·m/m)	Earth pressure (kN/m²)	Hydrostatic pressure (kN/m²)
0.00	0.00	0.00	0.00	3.36	0.00
-0.29	2.57	1.21	0.10	4.98	0.00
-0.59	5.40	2.96	0.62	6.66	0.00
-0.89	8.42	5.21	1.71	8.34	0.00
-1.19	11.62	7.96	3.52	10.02	0.00
-1.49	15.00	11.22	6.21	11.70	0.00
-1.79	18.56	14.98	9.92	13.38	0.00
-2.09	22.30	19.24	14.81	15.06	0.00
-2.39	26.23	24.01	21.03	16.73	0.00
-2.69	30.33	29.28	28.73	18.41	0.00
-2.99	34.62	35.06	38.05	20.09	0.00
Maximum	34.77 Elevation: -3.00 m	35.26 Elevation: -3.00 m	38.39 Elevation: -3.00 m	20.15 Elevation: -3.00 m	0.00 Elevation: 0.00 m

Elevation (m)	Axial (kN/m)	Shear (kN/m)	Bending moment (kN·m/m)	Earth pressure (kN/m²)	Hydrostatic pressure (kN/m²)
Minimum	0.00 Elevation: 0.00 m	0.00 Elevation: 0.00 m	-0.01 Elevation: -0.06 m	3.36 Elevation: 0.00 m	0.00 Elevation: 0.00 m

SELF WEIGHT AND SOIL PRESSURES

Elevation (m)	Axial (kN/m)	Shear (kN/m)	Bending moment (kN·m/m)	Earth pressure (kN/m²)	Hydrostatic pressure (kN/m²)
0.00	0.00	0.00	0.00	0.00	0.00
-0.29	2.22	0.24	0.01	1.62	0.00
-0.59	4.69	0.97	0.14	3.30	0.00
-0.89	7.35	2.22	0.54	4.98	0.00
-1.19	10.18	3.96	1.36	6.66	0.00
-1.49	13.20	6.21	2.75	8.34	0.00
-1.79	16.40	8.97	4.87	10.02	0.00
-2.09	19.78	12.22	7.86	11.70	0.00
-2.39	23.34	15.98	11.87	13.38	0.00
-2.69	27.08	20.25	17.06	15.06	0.00
-2.99	31.01	25.02	23.58	16.73	0.00
Maximum	31.14 Elevation: -3.00 m	25.19 Elevation: -3.00 m	23.83 Elevation: -3.00 m	16.79 Elevation: -3.00 m	0.00 Elevation: 0.00 m
Minimum	0.00 Elevation: 0.00 m	0.00 Elevation: 0.00 m	-0.00 Elevation: -0.11 m	0.00 Elevation: 0.00 m	0.00 Elevation: 0.00 m

SELF WEIGHT AND SOIL PRESSURES WITH A PERCENTAGE OF SURCHARGE AND SEISMIC ACTION

Elevation (m)	Axial (kN/m)	Shear (kN/m)	Bending moment (kN·m/m)	Earth pressure (kN/m²)	Hydrostatic pressure (kN/m²)
0.00	0.00	0.00	0.00	-0.00	0.00
-0.29	2.25	0.65	0.06	2.31	0.00
-0.59	4.84	2.04	0.39	4.70	0.00
-0.89	7.68	4.13	1.20	7.08	0.00
-1.19	10.78	6.95	2.71	9.47	0.00
-1.49	14.14	10.48	5.14	11.86	0.00
-1.79	17.76	14.72	8.69	14.24	0.00
-2.09	21.63	19.69	13.58	16.63	0.00
-2.39	25.77	25.37	20.03	19.02	0.00
-2.69	30.16	31.76	28.25	21.41	0.00
-2.99	34.81	38.87	38.47	23.79	0.00
Maximum	34.96 Elevation: -3.00 m	39.12 Elevation: -3.00 m	38.84 Elevation: -3.00 m	23.87 Elevation: -3.00 m	0.00 Elevation: 0.00 m
Minimum	0.00 Elevation: 0.00 m	0.00 Elevation: 0.00 m	0.00 Elevation: 0.00 m	-0.00 Elevation: 0.00 m	0.00 Elevation: 0.00 m

10. COMBINATIONS

LOADCASE

1 - Self weight
2 - Earth pressure
3 - Live load
4 - Seismic

COMBINATIONS FOR ULTIMATE LIMIT STATES

	Loadcase			
Combination	1	2	3	4
1	0.90	0.90		
2	1.40	0.90		
3	0.90	1.70		
4	1.40	1.70		
5	0.90	0.90	1.70	
6	1.40	0.90	1.70	
7	0.90	1.70	1.70	
8	1.40	1.70	1.70	
9	0.90	1.27		1.00
10	1.05	0.90		1.00

COMBINATIONS FOR SERVICEABILITY LIMIT STATES

	Loadcase		
Combination	1	2	3
1	1.00	1.00	
2	1.00	1.00	0.60

11. DESCRIPTION OF REINFORCEMENT

TOP OF WALL				
Top reinf.: 2Ø12 Anchorage infill / backfill: 16 / 15 cm				
SPANS				
No.	Infill		Backfill	
	Vertical	Horizontal	Vertical	Horizontal
1	#3@30 Splice: 0.3 m	#6@30	#6@25 Splice: 0.95 m	#6@30

FOOTING		
Reinforcement	Longitudinal	Transverse
Top	#6@30	#6@30 Extended anchorage length: 71.3 cm
Bottom	#6@30	#6@30
Length of hook at the start: 85 cm		

12. GEOMETRY AND STRENGTH CHECKS

Reference: Wall: Muro Samanta		
Code checks	Values	Status
Check for joint shear at base of wall/span: *Criteria of CYPE*	Maximum: 496.5 kN/m Calculated: 59.9 kN/m	Verified
Minimum thickness of panel: *Code ACI 318M-11. Article 14.5.3.2*	Minimum: 19 cm Calculated: 30 cm	Verified
Minimum spacing horizontal reinforcement: *Code ACI 318M-11. Article 7.6.1*	Minimum: 4 cm	
- Backfill:	Calculated: 28 cm	Verified
- Infill:	Calculated: 28 cm	Verified
Maximum spacing horizontal reinforcement: *Code ACI 318M-11. Article 7.6.5*	Maximum: 45 cm	

Reference: Wall: Muro Samanta		
Code checks	Values	Status
- Backfill:	Calculated: 30 cm	Verified
- Infill:	Calculated: 30 cm	Verified
Minimum horizontal geometrical ratio per face: *Code ACI 318M-11. Article 14.3.3*	Minimum: 0.00125	
- Backfill (-3.00 m):	Calculated: 0.00316	Verified
- Infill (-3.00 m):	Calculated: 0.00316	Verified
Minimum mechanical ratio - horizontal by face: *Criteria of CYPE (Horizontal reinforcement > 20% Vertical reinforcement)*	Calculated: 0.00316	
- Backfill:	Minimum: 0.00076	Verified
- Infill:	Minimum: 0.00015	Verified
Minimum geometrical ratio tension face - vertical: - Backfill (-3.00 m): *Code ACI 318M-11. Article 14.3.2*	Minimum: 0.00075 Calculated: 0.0038	Verified
Minimum mechanical ratio tension face - vertical: - Backfill (-3.00 m): *Code ACI 318M-11. Article 10.5.1*	Minimum: 0.00339 Calculated: 0.0038	Verified
Minimum geometrical ratio compression face - vertical: - Infill (-3.00 m): *Code ACI 318M-11. Article 14.3.2*	Minimum: 0.0006 Calculated: 0.00079	Verified
Maximum geometrical ratio - vertical total: - (0.00 m): *Code ACI 318M-11. Article 10.9.1*	Maximum: 0.08 Calculated: 0.00459	Verified
Minimum spacing vertical reinforcement: *Code ACI 318M-11. Article 7.6.1*	Minimum: 4 cm	
- Backfill, vertical:	Calculated: 21.1 cm	Verified
- Infill, vertical:	Calculated: 28 cm	Verified
Maximum bar spacing: *Code ACI 318M-11. Article 7.6.5*	Maximum: 45 cm	
- Vertical reinf. Backfill, vertical:	Calculated: 25 cm	Verified
- Vertical reinf. Infill, vertical:	Calculated: 30 cm	Verified
Check for combined axial and bending: *Check carried out per unit length of wall*		Verified
Check for shear: *Code ACI 318M-11. Article 11.2.1.2*	Maximum: 145.2 kN/m Calculated: 52.7 kN/m	Verified
Check for cracking caused by tensile stresses in the bars: *Code ACI 318M-11. Article 10.6.4*	Maximum: 243.2 MPa Calculated: 195.184 MPa	Verified
Lap splice lengths: *Code ACI 318M-11. Article 12.15.1*		
- Base backfill:	Minimum: 0.92 m Calculated: 0.95 m	Verified
- Base infill:	Minimum: 0.3 m Calculated: 0.3 m	Verified
Check of the base reinforcement anchorage at the 'top of wall': *Criteria of CYPE*		
- Backfill:	Minimum: 15 cm Calculated: 15 cm	Verified
- Infill:	Minimum: 0 cm Calculated: 16 cm	Verified
Minimum longitudinal area for the top layer of the 'top of wall' beam: *Criteria of CYPE*	Minimum: 2.2 cm² Calculated: 2.2 cm²	Verified
All the checks have been verified		
Additional information:		

Reference: Wall: Muro Samanta		
Code checks	Values	Status
- Elevation of the section with the minimum 'horizontal steel / vertical steel' ratio Backfill: -3.00 m - Elevation of the section with the minimum 'horizontal steel / vertical steel' ratio Infill: -3.00 m - Critical section under combined flexure: Elevation: -3.00 m, Md: 65.27 kN·m/m, Nd: 41.45 kN/m, Vd: 59.94 kN/m, Maximum steel stress: 411.891 MPa - Critical shear section: Elevation: -2.79 m		

Reference: Strip footing: Muro Samanta		
Code checks	Values	Status
Stability check: *Value introduced by the user.*		
- Safety factor against overturning (Persistent situations):	Minimum: 1.8 Calculated: 5.7	Verified
- Safety factor against overturning (Accidental seismic situations):	Minimum: 1.2 Calculated: 4.76	Verified
- Safety factor against sliding (Persistent situations):	Minimum: 1.5 Calculated: 3.91	Verified
- Safety factor against sliding (Accidental seismic situations):	Minimum: 1.2 Calculated: 3.09	Verified
Minimum depth: - Footing: *Code ACI 318M-11. Article 15.7*	Minimum: 15 cm Calculated: 50 cm	Verified
Soil bearing pressures: *Value introduced by the user.*		
- Average bearing pressure (Persistent situations):	Maximum: 0.6 MPa Calculated: 0.0689 MPa	Verified
- Maximum bearing pressure (Persistent situations):	Maximum: 0.75 MPa Calculated: 0.0723 MPa	Verified
- Average bearing pressure (Accidental seismic situations):	Maximum: 0.6 MPa Calculated: 0.0615 MPa	Verified
- Maximum bearing pressure (Accidental seismic situations):	Maximum: 0.9 MPa Calculated: 0.0755 MPa	Verified
Footing bending: *Code check based on resistance criteria*	Calculated: 9.5 cm²/m	
- Backfill top reinforcement:	Minimum: 3.51 cm²/m	Verified
- Backfill bottom reinforcement:	Minimum: 0 cm²/m	Verified
- Infill bottom reinforcement:	Minimum: 2.13 cm²/m	Verified
Shear force: *Code ACI 318M-11. Article 11.2.1.1*		
- Backfill (Persistent situations):	Maximum: 283.9 kN/m Calculated: 43.8 kN/m	Verified
- Backfill (Accidental seismic situations):	Maximum: 227.1 kN/m Calculated: 30.4 kN/m	Verified
- Infill (Persistent situations):	Maximum: 283.9 kN/m Calculated: 36.3 kN/m	Verified
- Infill (Accidental seismic situations):	Maximum: 227.1 kN/m Calculated: 25.6 kN/m	Verified
Anchorage length:		
- Backfill starter bars: *Code ACI 318M-11. Article 12.5*	Minimum: 25.1 cm Calculated: 38.6 cm	Verified
- Infill starter bars: *Code ACI 318M-11. Article 12.5.1*	Minimum: 15 cm Calculated: 38.6 cm	Verified
- Backfill bottom reinforcement (Anchorage hook): *Code ACI 318M-11. Article 12.5.1*	Minimum: 0 cm Calculated: 0 cm	Verified

Reference: Strip footing: Muro Samanta		
Code checks	Values	Status
- Infill bottom reinforcement (Anchorage hook): *Code ACI 318M-11. Article 12.5.1*	Minimum: 0 cm Calculated: 0 cm	Verified
- Backfill top reinforcement (Anchorage hook): *Code ACI 318M-11. Article 12.5.1*	Minimum: 0 cm Calculated: 0 cm	Verified
- Infill top reinforcement: *Code ACI 318M-11. Article 12.2.2*	Minimum: 71.3 cm Calculated: 71.3 cm	Verified
Cover: - Lateral: *Code ACI 318M-11. Article 7.7.1*	Minimum: 7.5 cm Calculated: 7.5 cm	Verified
Minimum diameter: *Criteria of CYPE.*	Minimum: #3	
- Bottom transverse reinforcement:	Calculated: #6	Verified
- Bottom longitudinal reinforcement:	Calculated: #6	Verified
- Top transverse reinforcement:	Calculated: #6	Verified
- Top longitudinal reinforcement:	Calculated: #6	Verified
Maximum bar spacing: *Code ACI 318M-11. Article 7.6.5*	Maximum: 45 cm	
- Bottom transverse reinforcement:	Calculated: 30 cm	Verified
- Top transverse reinforcement:	Calculated: 30 cm	Verified
- Bottom longitudinal reinforcement:	Calculated: 30 cm	Verified
- Top longitudinal reinforcement:	Calculated: 30 cm	Verified
Minimum bar spacing: *Code ACI 318M-11. Article 7.6.1*	Minimum: 4 cm	
- Bottom transverse reinforcement:	Calculated: 30 cm	Verified
- Top transverse reinforcement:	Calculated: 30 cm	Verified
- Bottom longitudinal reinforcement:	Calculated: 30 cm	Verified
- Top longitudinal reinforcement:	Calculated: 30 cm	Verified
Minimum geometric ratio: *Code ACI 318M-11. Article 7.12.2.1*	Minimum: 0.001	
- Bottom longitudinal reinforcement:	Calculated: 0.0019	Verified
- Top longitudinal reinforcement:	Calculated: 0.0019	Verified
- Bottom transverse reinforcement:	Calculated: 0.0019	Verified
- Top transverse reinforcement:	Calculated: 0.0019	Verified
Minimum mechanical ratio: *Code ACI 318M-11. Article 10.5*	Calculated: 0.0019	
- Bottom transverse reinforcement:	Minimum: 0.00056	Verified
- Top transverse reinforcement:	Minimum: 0.00093	Verified
All the checks have been verified		
Additional information:		
- Worst case bending moment of the backfill reference section: 51.57 kN·m/m		
- Worst case bending moment of the infill reference section: 30.99 kN·m/m		

13. STABILITY CHECKS (WORST CASE FAILURE PLANE)

Reference: Stability checks (Worst case failure plane): Muro Samanta		
Code checks	Values	Status
Worst case failure plane: *Value introduced by the user.* - Combinations without earthquale loading. Phase: Coordinates of the circle centre (-0.75 m ; 3.64 m) - Radius: 7.64 m:	Minimum: 1.5 Calculated: 2.11	Verified
- Combinations with earthquake loading. Phase: Coordinates of the circle centre (-0.75 m ; 3.64 m) - Radius: 7.64 m:	Minimum: 1.2 Calculated: 1.997	Verified
All the checks have been verified		

14. QUANTITIES

Reference: Wall		Grado 60			Total
Name of reinf.		#3	Ø12	#6	
Base transverse reinforcement	Length (m) Weight (kg)	18x3.09 18x1.73			55.62 31.13
Longitudinal reinforcement	Length (m) Weight (kg)			11x4.85 11x10.85	53.35 119.36
Base transverse reinforcement	Length (m) Weight (kg)			21x3.07 21x6.87	64.47 144.24
Longitudinal reinforcement	Length (m) Weight (kg)			11x4.85 11x10.85	53.35 119.36
Top wall beam reinforcement	Length (m) Weight (kg)		2x4.85 2x4.31		9.70 8.61
Bottom reinforcement - Transverse	Length (m) Weight (kg)			18x2.75 18x6.15	49.50 110.74
Bottom reinforcement - Longitudinal	Length (m) Weight (kg)			11x4.85 11x10.85	53.35 119.36
Top reinf. - Transverse	Length (m) Weight (kg)			18x2.44 18x5.46	43.92 98.26
Top reinf. - Longitudinal	Length (m) Weight (kg)			7x4.85 7x10.85	33.95 75.95
Starter bars - Transverse - Left	Length (m) Weight (kg)	18x1.53 18x0.86			27.54 15.41
Starter bars - Transverse - Right	Length (m) Weight (kg)			21x2.18 21x4.88	45.78 102.42
Total	Length (m) Weight (kg)	83.16 46.54	9.70 8.61	397.67 889.69	 944.84
Total with loss (10.00%)	Length (m) Weight (kg)	91.48 51.19	10.67 9.48	437.44 978.65	 1039.32

Quantities summary (including fabrication loss)

	Grado 60 (kg)				Concrete (m³)	
Element	#3	Ø12	#6	Total	f'c=280	Mud slab
Reference: Wall	51.19	9.47	978.66	1039.32	11.75	1.45
Total	51.19	9.47	978.66	1039.32	11.75	1.45