AASHTO DESIGN METHOD
서해안고속도로 매송휴게소 부지조성공사

PROJECT IDENTIFICATION

Title: 서해안고속도로 매송휴게소 부지조성공사
Project Number: H=3.5M+0.7
Client:
Designer: (주)동운산업개발
Station Number:

Description:

Company's information:

Name:
Street:

,
Telephone #:
Fax #:
E-Mail:

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PROGRAM MODE: DESIGN
of a SIMPLE STRUCTURE
using GEOGRID as reinforcing material.

DESIGN DATA

DESIGN OBJECTIVES

Minimum factor of safety against pullout, Fs-po	2.00
Minimum factor of safety against direct sliding, Fs-sliding	1.50
Maximum allowable eccentricity ratio at each reinforcement level, e/L	0.1667
Minimum factor of safety against compound and overall failure, Fs-comp-static	1.30
Minimum factor of safety against compound and overall failure, Fs-comp-seismic	1.10

Prescribed minimum resistive length to prevent pullout, Le = 1.00 m.
Prescribed minimum normalized length of each layer is: L/Hd = 0.70 --> L = 2.45 m.
Prescribed minimum absolute total length of each layer is: L = 2.80 m.

BEARING CAPACITY

Bearing capacity is controlled by general shear.

Maximum permissible eccentricity ratio (soil), e/L	0.1667
Minimum factor of safety with respect to ultimate bearing capacity (Meyerhof approach)	2.50

Bearing capacity coefficients: Nc = 30.14 N_γ = 22.40

SOIL DATA

REINFORCED SOIL

Unit weight, γ	18.0 kN/m
Design value of internal angle of friction, ϕ	30.0

RETAINED SOIL

Unit weight, γ	18.0 kN/m
Design value of internal angle of friction, ϕ	30.0

FOUNDATION SOIL (Considered as an equivalent uniform soil)

Equivalent unit weight, $\gamma_{equiv.}$	18.0 kN/m
Equivalent internal angle of friction, $\phi_{equiv.}$	30.0
Equivalent cohesion, $c_{equiv.}$	0.0 kPa

Water table does not affect bearing capacity

LATERAL EARTH PRESSURE COEFFICIENTS

Ka (internal stability) = 0.3333 (if batter is less than 10? Ka is calculated from eq. 15. Otherwise, eq. 38 is utilized)
Inclination of internal slip plane, ψ = 60.00? (see Fig. 28 in DEMO 82).
Ka (external stability) = 0.3384 (if batter is less than 10? Ka is calculated from eq. 16. Otherwise, eq. 17 is utilized)

SEISMICITY

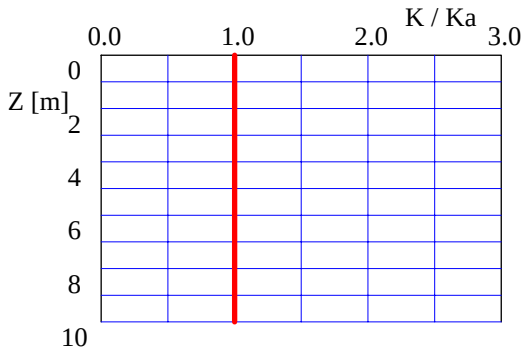
Not Applicable

INPUT DATA: Geogrids
(Multiple type reinforcement)

D A T A	Geogrid type #1	Geogrid type #2	Geogrid type #3	Geogrid type #4	Geogrid type #5
Tult [kN/m]	50.0	65.0	90.0	130.0	170.0
Durability reduction factor, RFd	1.0	1.0	1.0	1.0	1.0
Installation-damage reduction factor, RFid	1.10	1.10	1.10	1.10	1.10
Creep reduction factor, RFc	2.50	2.50	2.50	2.50	2.50
Fs-overall for strength	1.50	1.50	1.50	1.50	1.50
Coverage ratio, Rc	1.000	1.000	1.000	1.000	1.000
Friction angle along geogrid-soil interface, ρ	29.00	29.00	29.00	29.00	29.00
Pullout resistance factor, F*	0.85텮φ1	0.85텮φ1	0.85텮an	0.85텮an	0.85텮an
Scale-effect correction factor, α	0.8	0.8	0.8	0.8	0.8

Variation of Lateral Earth Pressure Coefficient With Depth

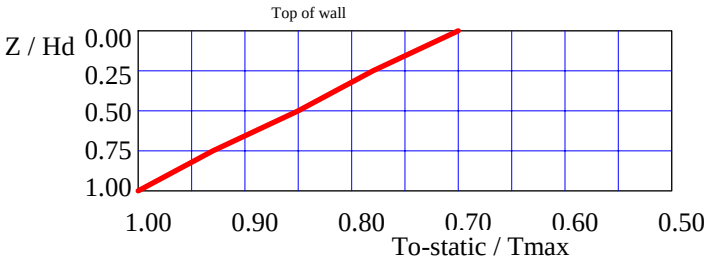
Z	K / Ka
0 m	1.00
1 m	1.00
2 m	1.00
3 m	1.00
4 m	1.00
5 m	1.00
6 m	1.00



INPUT DATA: Facia and Connection
(Design)

FACIA type: Facing enabling frictional connection of reinforcement (e.g., modular concrete blocks, gabions)
Depth/height of block is 0.30/0.20 m. Horizontal distance to Center of Gravity of block is 0.15 m.
Average unit weight of block is γ_f = 24.00 kN/m

Z / Hd	To-static / Tmax
0.00	0.70
0.25	0.78
0.50	0.85
0.75	0.93
1.00	1.00



To-static, To-seismic = connection force, static and superimposed dynamic component, respectively.

Geogrid Type #1		Geogrid Type #2		Geogrid Type #3		Geogrid Type #4		Geogrid Type #5	
σ (1)	CRu (2)	σ	CRu	σ	CRu	σ	CRu	σ	CRu
50.0	0.90	50.0	0.90	50.0	0.90	50.0	0.90	50.0	0.90
120.0	0.90	120.0	0.90	120.0	0.90	120.0	0.90	120.0	0.90

Geogrid Type #1		Geogrid Type #2		Geogrid Type #3		Geogrid Type #4		Geogrid Type #5	
σ	CRs (3)	σ	CRs	σ	CRs	σ	CRs	σ	CRs
0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00	0.0	0.00
50.0	0.90	50.0	0.90	50.0	0.90	50.0	0.90	50.0	0.90

(1) σ = Confining stress in between stacked blocks [kPa]
(2) CRu = Tult-connection / Tult-geogrid
(3) CRs = Tpo-connection / Tult-geogrid

D A T A (for connection only)	Type #1	Type #2	Type #3	Type #4	Type #5
Product Name	50KN	65KN	90KN	130KN	170KN
Durability reduction factor, RFd	1.00	1.00	1.00	1.00	1.00
Creep reduction factor, RFc	2.50	2.50	2.50	2.50	2.50
Overall factor of safety: connection break, Fs	1.50	1.50	1.50	1.50	1.50
Overall factor of safety: connection pullout, Fs	1.50	1.50	1.50	1.50	1.50

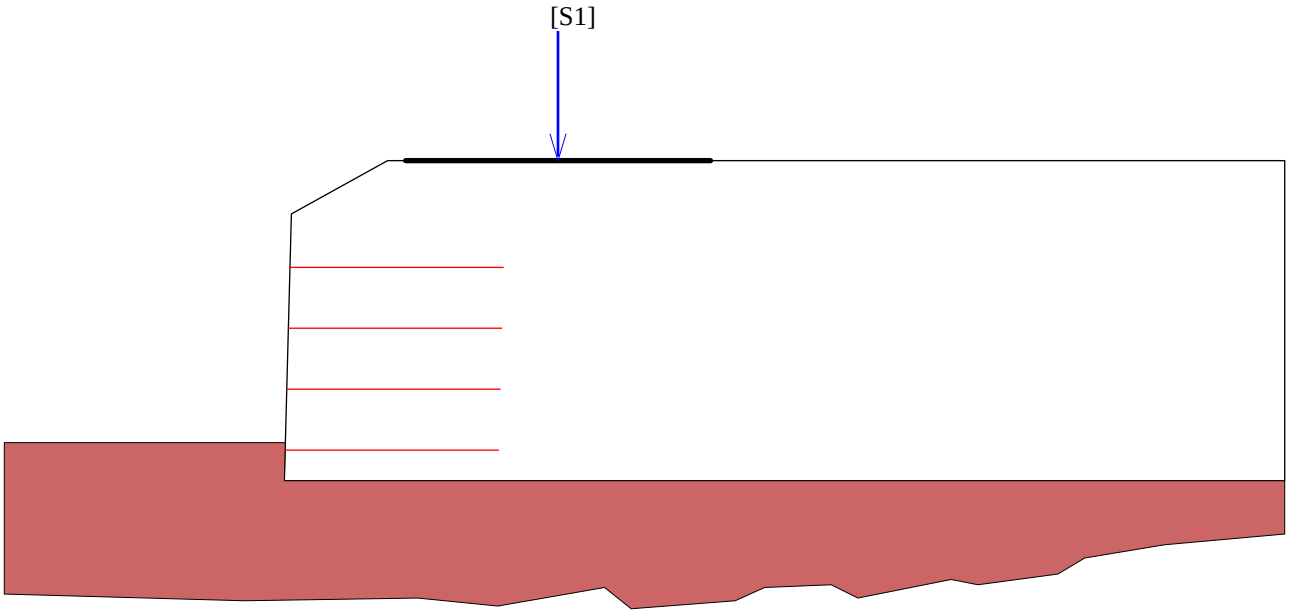
INPUT DATA: Geometry and Surcharge loads (of a SIMPLE STRUCTURE)

Design height, Hd	3.50	[m]	{ Embedded depth is E = 0.50 m, and height above top of finished bottom grade is H = 3.00 m }
Batter, ω	1.5	[deg]	
Backslope, β	29.0	[deg]	
Backslope rise	0.7	[m]	Broken back equivalent angle, I = 5.71? (see Fig. 25 in DEMO 82)

U N I F O R M S U R C H A R G E
Uniformly distributed dead load is 0.0 [kPa]

OTHER EXTERNAL LOAD(S)
[S1] Strip Load, Qv-d = 0.0 and Qv-l = 13.0 [kPa].
Footing width, b=4.0 [m]. Distance of center of footing from wall face, d = 3.5 [m] @ depth of 0.0 [m] below soil surface.

DESIGNED REINFORCEMENT LAYOUT:



SCALE:

0 2 4 6[m]

REINFORCEMENT LAYOUT AND DESIGN CRITERIA

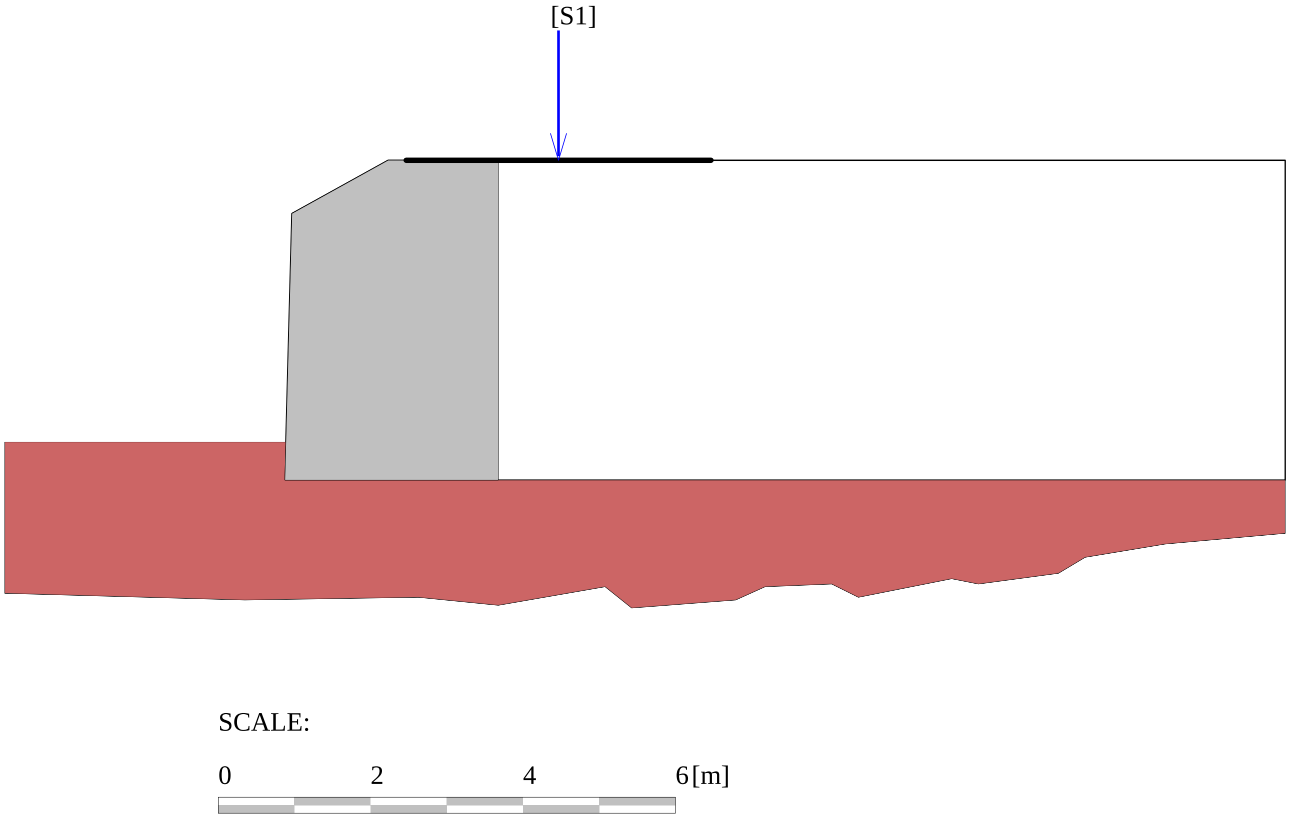
LEGEND: (1) Connection strength — √ Satisfactory
(2) Geogrid strength — ⊗ Unsatisfactory
(3) Pullout resistance
(4) Direct sliding
(5) Eccentricity

Bearing capacity: √
Foudation Interface: Direct sliding √ ; Eccentricity √

#	Geogrid Elevation [m]	Length [m]	Type #	(1)	(2)	(3)	(4)	(5)
1	0.40	2.80	3	√	√	√	√	√
2	1.20	2.80	2	√	√	√	√	√
3	2.00	2.80	1	√	√	√	√	√
4	2.80	2.80	1	√	√	√	√	√

BEARING CAPACITY for DESIGNED LAYOUT

	STATIC	SEISMIC	UNITS
(Water table does not affect bearing capacity)			
Ultimate bearing capacity, q-ult	427.1	N/A	[kPa]
Meyerhof stress, σ_V	104.86	N/A	[kPa]
Eccentricity, e	0.34	N/A	[m]
Eccentricity, e/L	0.122	N/A	
Fs calculated	4.07	N/A	
Base length	2.80	N/A	[m]



DIRECT SLIDING for DESIGNED LAYOUT
(for GEOGRID reinforcements)

Specified Fs-static = 1.500

Along reinforced and foundation soils interface: Fs-static = 1.764

#	Geogrid Elevation [m]	Geogrid Length [m]	Fs Static	Fs Seismic	Geogrid Type #	Product name
1	0.40	2.80	1.815	N/A	3	90KN
2	1.20	2.80	2.116	N/A	2	65KN
3	2.00	2.80	2.522	N/A	1	50KN
4	2.80	2.80	3.068	N/A	1	50KN

ECCENTRICITY for DESIGNED LAYOUT

At interface with foundation: e/L static = 0.1526; Overturning: Fs-static = 2.82

#	Geogrid Elevation [m]	Geogrid Length [m]	e / L Static	e / L Seismic	Geogrid Type #	Product name
1	0.40	2.80	0.1253	N/A	3	90KN
2	1.20	2.80	0.0757	N/A	2	65KN
3	2.00	2.80	0.0313	N/A	1	50KN
4	2.80	2.80	-0.0144	N/A	1	50KN

RESULTS for STRENGTH

#	Geogrid Elevation [m]	Tavailable [kN/m]	Tmax [kN/m]	Tmd [kN/m]	Specified minimum Fs-overall static	Actual calculated Fs-overall static	Specified minimum Fs-overall seismic	Actual calculated Fs-overall seismic	Product name
1	0.40	32.7	19.2	N/A	1.500	1.702	N/A	N/A	90KN
2	1.20	23.6	15.5	N/A	1.500	1.521	N/A	N/A	65KN
3	2.00	18.2	11.9	N/A	1.500	1.523	N/A	N/A	50KN
4	2.80	18.2	10.7	N/A	1.500	1.694	N/A	N/A	50KN

RESULTS for PULLOUT

#	Geogrid Elevation [m]	Coverage Ratio	Tmax [kN/m]	Tmd [kN/m]	Le [m]	La [m]	Avail.Static Pullout, Pr [kN/m]	Specified Static Fs	Actual Static Fs	Avail.Seism. Pullout, Pr [kN/m]	Specified Seismic Fs	Actual Seismic Fs
1	0.40	1.000	19.23	N/A	2.58	0.22	133.6	2.000	6.946	N/A	N/A	N/A
2	1.20	1.000	15.54	N/A	2.14	0.66	88.9	2.000	5.725	N/A	N/A	N/A
3	2.00	1.000	11.94	N/A	1.70	1.10	52.6	2.000	4.408	N/A	N/A	N/A
4	2.80	1.000	10.73	N/A	1.26	1.54	24.9	2.000	2.317	N/A	N/A	N/A

RESULTS for CONNECTION (static conditions)

#	Geogrid Elevation [m]	Connection force, To [kN/m]	Reduction factor for connection (short-term strength) CRult	Reduction factor for connection (long-term strength) CRcr	Available connection strength [kN/m]		Available Geogrid strength, Tavailable [kN/m]	Fs-overall connection strength Specified	Fs-overall connection strength Actual			Fs-overall Geogrid strength Specified	Fs-overall Geogrid strength Actual	Product name
1	0.40	18.6	0.90	0.90	32.4	80.5	32.7	1.50	1.74	1.50	4.33	1.50	1.76	90KN
2	1.20	14.0	0.90	0.90	23.4	58.2	23.6	1.50	1.67	1.50	4.16	1.50	1.69	65KN
3	2.00	9.9	0.90	0.64	18.0	32.2	18.2	1.50	1.82	1.50	3.25	1.50	1.83	50KN
4	2.80	8.2	0.90	0.30	18.0	15.0	18.2	1.50	2.20	1.50	1.83	1.50	2.22	50KN